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FREKE
ON
ORGANIZATION.

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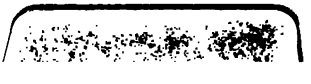

REFLECTIONS

ON

ORGANIZATION;

OR,

SUGGESTIONS FOR THE CONSTRUCTION

OF AN

ORGANIC ATOMIC THEORY.

BY

HENRY FREKE, A.B., M.B., T.C.D, M.R.I.A.

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TO

SIR HENRY MARSH, BART.

My dear Sir,

Could he, by adorning so unpretending a page with a name pre-eminently proud in that department of research, which sheds upon inquiries of its kind their brightest lustre,—could he, by giving it the impress of a stamp its own intrinsic merit might not claim,—convey, however faintly, the extent at once of his attachment to your person and admiration for your intellectual gifts, it were, though humble such a tribute to your worth, to realize the anxious wish of

HENRY FREKE.

DUBLIN, 28, HOLLES-STREET,
November 1, 1848.

PREFACE.

In submitting to the public the following reflections on organization, the Author has to regret that circumstances have induced him to do so in a form as incomplete, and to himself unsatisfactory, as it is remotely distinct from what he had originally contemplated.

Having been engaged some time back in analyzing for Sir Henry Marsh the blood of some of the clinical patients in Steevens' Hospital, the thought was suggested to him of hazarding some observations of his own on the physiology of that fluid.

He then conceived the design of tracing man progressively through the distinct stages of his developement: from the time of conception through utero-gestation to the period of birth; from that to maturity, during the period of his adaptation for the reproduction of his species; and from thence to have followed him in his progress towards decay. His object was to have pointed to what he conceived to be the physiological peculiarities of each of those periods, calling attention to what he regarded as the functions respectively of our so called incidental

constituents, namely, of potash and soda, of lime and magnesia, and of phosphorus and sulphur; while the motive which chiefly induced him to embark in such inquiries was the developement of certain views having a relation to practical medicine, and more especially to inflammation, as well ordinary as that called specific.

He now publishes, leaving such topics for the most part untouched on, while others, which have been but glanced at, he has been prevented from developing at all to the extent he had originally hoped. In relation, for instance, to his observations on the nature of death, it was his intention, in a more advanced part of his work, and when his views as to the nature of a complex organism like man had become somewhat intelligible, to have pointed to the great variety of contingencies upon which the period of death's occurrence, as a natural event, must, in an organism of much complexity, of necessity, be dependent. Such intentions, with others, he has been obliged to abandon.

Having brought his inquiries to their present position, (an outline of what he had hoped to have realized,) the Author was in the autumn of 1847, honoured by the Central Board of Health in Ireland with an appointment as Inspector of the Government Hospitals throughout the country under the temporary Fever Acts, and thus had his attention withdrawn from such pursuits.

In the spring of 1848, while in the discharge of his official duties as Inspector of Hospitals, he contracted malignant typhus fever, and on recovery was induced to leave Ireland for a time. He has now returned, and finding that other avocations, as well as considerations of a different kind, make it imperative on him to abandon his original intention, he feels somewhat reluctant to carry into execution his primary impulse of committing so unfinished a fragment to the flames. Trusting, then, to their leniency towards his many defects, and, it may be, his numerous errors, the Author now ventures to submit his reflections as they stand to the indulgent consideration of his professional brethren. His regret at being unable to put into execution his contemplated plan has, at the same time, been lessened by the reflection, that should his foundation possess any firmness, the superstructure will be erected by abler workmen; while (which is, perhaps, the more likely result) should it prove to be unstable, escaping the painful realization of a laboured application of valueless views, he shall be spared the mortification of seeing his edifice in the position of the house which was built upon sand.

H. F.

Some apology may be required for the application to which the term "physics" has in the following obser-

vations been restricted. Regarding it as a consideration of considerable moment, accurately to discriminate between the *general* properties of matter and such as are peculiar to it *as a species*, and knowing no word in our language which to him appears appropriately and exclusively to comprehend under it the former, the Author has taken the liberty of employing the term "physical" in that sense as being one which would appear to be used with some latitude by writers on the Continent.

November 1, 1848.

REFLECTIONS ON ORGANIZATION.

CHAPTER I.

INANIMATE CREATION.

THERE are but few topics in the contemplation of which the human mind can become occupied, which so early invest it with sentiments of a character of the same reverential solemnity, or impress on it the same humiliating conviction of its own real littleness, as do inquiries into the *causes* of nature's phenomena. The final cause of all things, the true philosopher is soon taught, is but the will of an Omnipotent; and while he feels that all efforts at research into the *nature* of That Will are not alone inconsistent with a rational judgment, but at the same time demonstrative of an impious presumption, he is—as in humility bending to adore an Infinite Intelligence—apprehensive of wandering in his inquiries to an illegitimate distance.

At no moment do such reflections become more deeply impressed than when the thoughts dwell on the consideration of the forces which give action to matter; and our first impulse might be—recognizing therein a result into whose cause it was undesigned we should inquire, and

shuddering at a suggestion alike profane and irrational—to shrink from an effort so impiously vain as the withdrawal of that veil within which an Eternal has enshrined an omnipotent will. But when reflection is controlled to the results of experience, we soon learn to recognize the true limits of research; and thus it is, when we reflect that from our earliest intercourse with operative nature, we have experienced a consistency and an uniformity in her laws of operation; when we reflect that at each of such communes, at moments when results were in progress of developement, means for their production have been for the most part experienced; and when we reflect how multitudinous and varied are those products which, apparently distinct and dissimilar, experience tells eventuate from one active cause, we are compelled, as a result of such experimental reflection, to impute each definite product to some definite cause. We feel our researches to be legitimate and sanctioned while confined to connecting the distinct ends which may be resultants of the same active means; so long as—unconcerned with inquiries into the *nature* of a cause—they are alone employed in observing its operations and effects. Nay, to such inquiries we turn, not merely as to a privilege which has not been prohibited; but regarding them as a duty towards which we feel ourselves as it were morally urged, we with eagerness read creation, that therefrom we may learn to adore the Creator.

It is with feelings duly alive to the importance and momentous bearing of such reflections, we would now briefly engage in the contemplation of certain vital phenomena, and that with no design of inquiring into the *nature* of the cause; but with a desire of pointing to what, to us,

appears to be a recognizable connection between certain well known effects and what we conceive to be their cause.

We would in the first place, then, direct attention, as bearing importantly upon our subject, to the following generally received facts in relation to the component constituents of the inanimate world.

Its Originator, when calling this world into being, limited omnipotence in matter's formation to the creation of but a few distinct species. That share in the material universe of which man forms a part, has, so far as scientific research hath attained, the elements of its construction confined to a number less numerous than three score. These elements were so constructed as to constitute countless myriads of inconceivably minute particles, which particles, from their indivisibility, have been designated atoms. On each such atom were impressed two distinct classes of laws, namely, attributes general and specific; the former to constitute it what we designate matter, the latter to vary that matter in kind. Such attributes in operation constitute the objects respectively of physics and chemistry, and as a product thereof we have presented to us a mineral or inanimate world. By general attributes we imply those properties which may be predicated universally of all matter indiscriminately. In each species are to be recognised distinguishing attributes, which, as they constitute it a distinct species, we would call its specific laws. Of inanimate matter's general attributes or laws, none are, perhaps, more conspicuous than its adaptation to be influenced by those agencies or forces called gravity, caloric, and electricity, with which all are familiar as the causes *generally* of activity or motion in matter; that is, as causes of action in all species of

matter in general. For this reason we would designate these agencies *General Forces*. Let us briefly contemplate the most conspicuous features in the mode of operation and connection with matter of these general forces, with the view of ascertaining if there be any fixed principle or law in relation to such operation and connection, which being predicable of each of these forces, may suggest the inquiry—is such principle common universally to *all* generally acting forces? Is it essential to the nature of general force? For should such be ascertained to be the fact—should it be discovered that *all general forces*, that is, *all forces which give activity to matter in general*, are controlled in their operation by a common fixed principle or law, we may thereby have disclosed to us that which, antecedently to all experimental researches thereon, may suggest somewhat of the principles which control the operative action and connection with matter of the general cause of *animate* motions, should any such general cause hereafter be found to exist.

In calling attention to the mode of operative action and connection with matter, of gravity, caloric, and electricity, it forms no part of our design to inquire into the nature or essential character of these agencies. Whether or not any or all of them may be reducible to, or be a modification of some still more abstract principle, are also inquiries with which we are now unconcerned. Of this, however, we are in possession of abundance of evidence, namely, that gravity, be it in its essential character of what nature it may, exercises its influence as an operative agent, *radiatingly*, that is, emanating as it were spherically, or in every direction. That gravity—be it in its essential character of what nature it may, is *essentially reciprocal* in its mode of

operative action; and thirdly, that gravity, though from contingent arrangements it now ever is active, would, under an altered contingency, be latent or unproductive of obvious results. The first of these three propositions being generally recognised, requires from us no further observation.

By the term reciprocal, as applied to gravity, we design to convey that for the manifestation of gravity as a force actuating matter, that is, as a principle acting on or through any given particle or atom of matter, there is required in addition the presence of something distinct from that atom. In other words, that gravity, as an active force, can alone be in operation between matter and matter; so that no particle of matter can manifest gravity till placed within the sphere of operation of something which bears to it the relation of reciprocal. For, remove in imagination to such distance in space a solitary atom of some species of matter, so as to place it beyond the sphere of the operation of all others, then its gravity, if inherent, must be obviously latent, that is, it must be unproductive of all active results. Or if experience will not warrant our imagining such position to exist, to which the influence of gravity may not possibly extend; annihilate, in imagination, all matter but that atom, then, though its attributes be unmodified—though its laws be unchanged, its gravity, if inherent, must be dormant or still. Replace that atom within the sphere of the operation of others, and then by a reciprocal interchange of action, we shall have *a nucleus atom surrounded by an envelope of atoms.*

The agency perhaps best known to all as a general cause of motion in matter, as well artificial as natural, is that called caloric. Whether caloric be a material

agent, whose particles are self-repellant, while they are attractive of those of ponderable matter, or its phenomena be more satisfactorily explicable on some different hypothesis, it concerns us not now to inquire. Against the correctness, however, of the following statements no question, we apprehend, will be raised, namely: 1st. That an agency called caloric is being perpetually transmitted in a radiating form from the centre of our solar system to earth and the other planets placed within the sphere of our sun's operation. 2nd. That the caloric thus transmitted can so combine itself with inanimate constituents, as to become latent, or, as it were, dormant or deprived of activity—that is, can so combine itself as to be unproductive of further apparent results than the construction of a modification in the arrangement of the constituents with which it so combines; while, by the destruction from any cause of this modified arrangement, the latency of the caloric may be at the same time destroyed, and then its influence as an active agent may at once become manifestly apparent. 3rdly. That the caloric, thus emancipated from association with inanimate matter, again radiates centrifugally in every direction, and may again exercise its influence upon such constituents as are placed within the sphere of its operation. And, 4thly. That the caloric thus radiated, if the constituents placed within the sphere of its operation be similar (but unmodified in arrangement) to those from which it was emancipated, will constitute in them the same modification in arrangement which previously existed in those it has left; and, having done so, will itself therein again become latent, the constituents with which it had previously been united being again reduced to the unmodified form; while it is during, and alone

during, the transit of the caloric from one set of constituents to the other, that activity or motion is apparent in either.

In the congelation of water by the melting of ice, we have presented to us a familiar example of each of these facts. We there see the caloric transmitted from the sun to the inanimate union of oxygen with hydrogen, so combine itself therewith, as to become latent or unproductive of further apparent results, than the construction of that modified arrangement of these constituents known to us by the name, water. This water, on being exposed to the influence of ice, we see yielding thereto its own latent caloric, thereby converting that ice into water, while itself becomes ice. *During* this process we see molecular motion in both water and ice, while at its close we find all has again become still; and had the water been originally placed in the centre of a surrounding mass of ice, we should have, as the final result, *a solid nucleus enclosed within an envelope of fluid.*

There is another fact which may be deduced from the contemplation of this process, to which we would solicit attention, and it is this, namely, that the matter (viz.: water) with which caloric has entered into latent combination, will not resign its latent caloric, unless to that which might be called such matter's *reciprocal*, or, perhaps, more correctly, its stimulus. Water, we well know, would, even at a temperature of 32° Farenheit, remain water for ever, unless placed within the sphere of the operation of that which is adapted to receive from it its latent caloric; unless exposed to the influence of that to which, from its condition as to union with caloric, the caloric latent in water has a tendency to be imparted. *Something*, then, is re-

quired to call the caloric latent in matter from latency to light—to arouse it from dormant inactivity to operative action. And what is that something? It is, and we would solicit attention to this fact, it is ***that which is below such matter in the scale of calorification;*** if we (for reasons which will presently become apparent) be allowed to adopt such expression. This is what we mean to imply, when we speak of such matter's reciprocal or stimulus, namely, that which is capable of calling into operative action the caloric which had previously been latent in matter.

It needs but to observe that to electricity the foregoing observations, as latency, reciprocity, radiation, transmission, &c. are equally applicable, such being too obvious to require illustration.

The inference, then, deducible from these observations on the operation of general forces, is—that among the fixed principles to which is controlled the operative action of all the known general causes of motion in inanimate matter, (and which may hereafter be found to be predicable of any analogous general force, should subsequent experience show such analogous force to exist,) may be recognized the following as common to all, viz.:—

They all enter into latent combination with inanimate matter, from which they can alone be aroused to activity by that matter's reciprocal or stimulus; they then radiate centrally, giving manifestation to active results, and range the reciprocal or stimulus round the inanimate matter in the form of an envelope surrounding a nucleus.

Before leaving the consideration of these general forces, we would offer but a word as to their operative *function*.

By the operation of these forces (whether alone or in conjunction with others) is all inanimate matter in being

held in constant control—all—alike the ultimate atom and the aggregate mass. By these (whether unaided, or conjointly with aid,) is the atom, as the mass, urged into activity, and caused to move throughout space; and by these are the atom and the mass restrained to the assigned limits within which through that space they may range. These, extending their controlling agency to wherever matter exists, range round some universal centre, and consign to a defined distance therefrom every thing called matter, wherewith space has been furnished. From the great centre of all that is material in creation, around which unnumbered and countless spheres are revolving, these universally-extending influences appear ever to emanate; one great function of which is manifestly to assign to all worlds existent their respective positions in the vast universe of worlds—to organize, if that term be admissible, all inanimate matter—in a word, to be the great organizing agencies of all inert creation.

Let us pause to contemplate in its wonderful vastness all matter, collectively, throughout space's abyss. Let us, viewing universal creation as an aggregate unity, regarding all worlds as harmoniously blended into one, analogically esteem creation as one vast organized structure—an organism of surpassing complexity and mightily compound; wondrous, yet, at the same time, harmonious; its elements constitute myriads of spheres; its integral parts form distinct solar systems. Those elementary constituents, namely, the countless worlds throughout space, by their relative arrangement constitute this organism's organization. Those integral parts, as our planetary system, give to inanimate creation's vast organism some symmetrical form, while to each, alike to the element and the integral, is assigned the exact

position in space it shall occupy; to each, as well to the atom as the aggregate, the exact limits, within which through that boundless abyss it may stray; and all are controlled into the harmony of unity, and kept in constant activity—we had almost said vitality—by the same great organizing influences emanating from the great centre of all.

Having thus briefly, yet so far as our purpose requires, considered such of inanimate matter's general attributes as bear upon our immediate inquiries, we would now, with a like brevity, glance at those of its specific attributes which have relation directly to the object in view.

The specific attributes of matter are, as we have observed, those which give to its distinct species their distinctions. It is at the bidding of their specific laws various kinds of matter unite, and by union give origin to new specific laws—produce in effect a new species of matter. It is, for example, in obedience to their specific laws that oxygen joins union with carbon, in which union we see resulting matter possessed of new specific laws. It is in obedience to their specific laws, that hydrogen combines itself with azote, in which compound we recognize distinct specific laws. And it is in obedience to these newly developed specific laws, we see these two compounds in conjoint union give origin to a new species of matter; give existence to matter of a well-defined and striking conformation; in a word, give being to a compound possessed of a crystallized form. There is one of the components of that crystal, namely, oxygen, to which we would direct a moment's attention, and that from the extraordinary importance of this element in nature.

There is no species of matter which lays stronger claims to our consideration than does oxygen, whether we con-

template earth physically or physiologically. In its physical relations, must be of moment to our planet an element which constitutes one-fourth of its crust, comprises eight-ninths of the unfathomable depths which lave three-fourths of its surface, and supplies four-fifths of that atmosphere within which all is enveloped. Nor is its physical importance more momentous than its physiological, its presence being found to be indispensably essential to all vital manifestation.

The attribute in this element, to which we would now direct attention, is its extraordinary tendency to unite with other matter—a tendency almost as universal as are the species. We are acquainted with but a solitary simple substance, and that, too, hypothetical, which is not known in combination with oxygen.

But there is a class of elementary substances known to chemists as the alkaligenous metals, between which and oxygen this affinity is of the greatest existing degree of intensity. The force of attraction which exists between oxygen and the metallic bases of the alkalies is the strongest with which chemistry presents us; under its influence these metals force oxygen from its combination with other elementary substances, as is exemplified by their instant decomposition of water.

There is but another circumstance, in connection with the crystal above mentioned, to which we would now direct attention, and that in reference to the combination of its elementary constituents. We said that hydrogen united to azote constituted one of its earlier formed components; that oxygen combined with carbon formed its other proximate principle; and have just stated that oxygen has a tendency also to unite with its other elements—hydro-

gen and azote. Its affinity for hydrogen is read in the wide ocean, which waters so large a share of our sphere; for azote, in the number of its atoms which congregate in union round a solitary atom of that element. But the circumstance to which we now refer as remarkable, is, that no efforts of man can directly unite hydrogen and azote; that in our atmosphere we find azote and oxygen for ever commingled, but no where combined; and that if hydrogen be added to oxygen, they may remain throughout time as a mechanical mixture, evincing no tendency chemically to combine; conditions other than mixture are required for the chemical combination of these elements. We know of but one circumstance under which azote can be made to unite chemically with hydrogen, and that is also found to be favourable to the union of other elementary substances. It is alone when azote, in that condition which chemists call nascent, (that is, at the moment of its being extracted from combination with some other species of matter,) is presented to hydrogen, that a union between these two elements takes place. It is then, and then only, the specific affinities between these elements result in a chemical union.

Let us now, having ascertained thus much (and it is all that our purpose requires) of the nature and attributes of inanimate matter, propose for consideration the following question:—Were man possessed of such control over the elements of earth, and over the forces which give to those elements action, that he could combine and mould in such union as seemed to him pleasing, the various species of matter and the agents which give them activity: and should it please him to combine, in conjunction with some general motor influence or imponderable agency, analogous to

caloric in its mode of operative manifestation, the elements of the crystal we have just been considering, and one of the alkaligenous metals, potassium or sodium: and should he so construct this combination of elements with the imponderable agency, that the latter should assign to the former the respective positions they should occupy, should control each to a defined distance from the centre of the whole, and make their relative position distinct from that which would result from the reciprocal operation of their chemical laws: and should he so constitute the imponderable agency, that the energy of its action (analogously to its analogue caloric, under analogous circumstances,) in controlling the distinct elements of the compound to the harmony of unity, should be thereby rendered latent or unproductive of further active results: and, finally, should he make the unity of the compound dependant on the aggregate's integrity,—what, we ask, should our experience lead us to expect as the result of the simultaneous withdrawal of the imponderable or controlling agency, and the exposure of this compound to the free action of oxygen? The result would be, that the extraordinary affinity between oxygen and the alkaligenous metal would cause them instantly to unite, and thereby would be produced a disturbance in the arrangement of the compound's constituents. The integrity of the aggregate being thus destroyed, it can no longer exist as an unity, and its elements now become amenable to the control of their chemical laws; and being all at this moment in the act of separation or disunion, namely, the condition of nascency, which we have just seen to be that most favourable to chemical union, they must chemically combine and form compounds; which, uniting, give being, as we have seen, to the already

mentioned crystallized form. But what becomes of the imponderable agency, whose energy had been previously employed in ranging and controlling the constituents of the compound? It is no longer so expended, and can, consequently, no longer be latent; emancipated, as it were, from the control of the specific attributes of matter, it now, unfettered, in obedience to the laws of its nature, radiates centrifugally and in every direction; and if matter of the same species as the compound possessed be exposed to the influence of such agency's operation, it will combine and range such matter into a new compound identical to the old. While, during its transit from one class of elements to the other, we should expect it would give manifestation to some active results, and, having formed the new compound, would itself therein again become latent.

Such results our experience of matter and its attributes has taught us to anticipate would accrue from the withdrawal of the general motor influence from materials thus hypothetically combined, simultaneously with the free action of oxygen thereon, were we in possession of power to construct such a compound. Man has not that power;—But He who framed all things according to the fashion of His will; He, with a power which is infinite as wise, *has* constructed such compounds, and exposed them to oxygen, supplying at the same time such means as could withdraw imponderable influence. Let us not, however, anticipate; but before proceeding to the application of these observations, briefly recapitulate what has already been advanced.

SUMMARY.

1st. Experience has disclosed to us an inanimate creation, composed of multitudinous worlds definitely formed and arranged, the whole constituting one vast, though concrete or aggregate, unity, comprised in unnumbered separate systems, formed of individual worlds which are constructed (at least so far as our world is concerned) of myriads of atoms of a very *limited number of distinct species of matter*.

2ndly. Experience has disclosed to us, that this vast inanimate creation—system, worlds, and ultimate elements, are put in action and restrained—are arranged and controlled into the harmony of unity, by the same great general attributes or agencies which, as operative agents, radiate centrally and in every direction; alike from the great centre of all—from the centre of systems—from the centre of worlds and of ultimate atoms; that during the transit of these general agencies from centre to centre, they give manifestation to conspicuously active results—they give to the universe motion and harmonious arrangements—they give inanimate creation *its* organization and life.

3rdly. Experience has disclosed to us, that these general attributes or agencies may, by uniting or combining themselves with inanimate matter, keep its molecular constituents at definite distances, and may have their energy, as active agents therein, so completely expended, as to be no further productive of active results; that is, may have their energy in that condition which may be expressed by the term latent or dormant. While the

destruction of this molecular distance, destroying such latency, gives free emancipation to the general agency or force.

4thly. Experience has disclosed to us, that when these general agencies or forces have entered into latent combination with matter, they can alone be aroused from such latency to manifest action by the operation of something which bears to that matter the relation of reciprocal or stimulus; and the reciprocal or stimulus then becomes ranged round the matter, in the form of an envelope surrounding a nucleus.

5thly. Experience has disclosed to us, that the distinct species of matter which constitute our planet, brought into union and reunion by their own specific laws, give being to the vast variety of regularly formed compounds which are found among the inanimate components of this world.

6thly. Experience has disclosed to us, that the affinity between oxygen and the alkaligenous metals is the strongest which exists between the elements of earth.

And, lastly—Experience has disclosed to us, that nascency is a condition favourable to the chemical union of elements.

CHAPTER II.

ANIMATE CREATION.

THE announcement by the sacred historian, that when the universe's Architect, looking upon the completion of His six days' great work, "saw everything that He had made, and behold it was very good," is a record in holy writ of a divine perfection in nature. That all the institutions of an infinite intelligence were pronounced by a divine omniscient emphatically *good*, has established for each an absolute perfection. As it is, it is perfect—to be otherwise were to be defective. Hence it is we regard it, that analogy is in the natural world a channel which is calculated to conduct to the most triumphant results. For what is analogic reasoning on natural events, but an acknowledgment on man's part, that God's laws are perfect? What, but a recognition of a divine perfection in ALL nature's arrangements? Having, for example, become acquainted with the operative means employed for the production of any natural result, and having acquiesced in the absolute perfection of that means, in seeking to trace an analogous result to an analogous means, we but assert our belief that the *sought means* too will exhibit perfection. If then, having made ourselves familiar with the fixed principles to which is controlled the operative action of all the known general causes of motion, it were announced to us that in some especial department of nature, a newly discovered general motor influence had been found in active

operation—a new cause of matter's motion had been seen generally to obtain; might we not, setting analogy as the guide of our reason, knowing that nature has in operation the *best* means for *every* result; might we not, regardless altogether of the essential character of that agent, unconcerned as to its dependency or otherwise upon some still more general cause; might we not, antecedently to all experimental researches thereon, be in some degree prepared to predicate certain *a priori* probabilities as to the mode of operative action and connection with matter of this newly discovered general cause of its movements? Should we not be warranted *a priori* in the conjecture, that it would be found to enter into latent combination with matter from which it could alone be aroused to activity by that matter's reciprocal or stimulus; that it would then radiate centrifugally in every direction, giving manifestation during such radiation to active results, and ranging the reciprocal or stimulus round the matter in the form of an envelope surrounding a nucleus?

But has such new general motor influence been found to exist? Has such new cause of activity in matter been seen in general operation? In endeavouring to ascertain this fact, we shall in the first place inquire what probability there is that such force does exist, and secondly, what evidence there is of its existence.

First, then, as to its probability. Every phenomenon must be reducible to one of three categories, that is, it must be moral, physical,* or physiological. That the moral constitution of this world has been so arranged,

* We here employ the term physical in an extended signification, meaning thereby to express inanimate phenomena generally, including such as are physical, properly so called, and chemical.

that its phenomena have been made dependent upon an opposition or antagonism, as it were, of forces, is a truth of which we are too constantly and painfully made aware to admit its being questioned, even had the divine record of its reality been withheld. In the recognition of this truth, experimentally and unaided by revelation, we can readily read the origin of various theories in theology. To the Manichæans, for instance, it suggested that two deities, possessed of an equality of power—the one a malignant, the other a good—preside over and control the events of creation. But to us has been disclosed, by an inspired revelation, that an omnipotent Creator and Disposer of all has, for the fulfilment of His moral designs, sanctioned the existence of a power which is opposed to His own; and on the antagonism between these two powers, namely, Satanic and Divine, He has been pleased to make dependent the existence of earth's moral results. How wondrous to man's finite wisdom appears this great moral truth. A force in existence opposing Omnipotence! But when he turns from the contemplation of the moral to that of the physical world, and finds the same principle, antagonism, here too to prevail; when he sees that the harmony of the universe is alone maintained by the operation of antagonizing powers—that a centripetal and a tangental force are required for the organization of space, he is struck with the universality of this principle. And if, while reflecting on his experience in these two great domains, his inquiries be directed to researches in the third—involuntarily as it were, and antecedently to all experimentally acquired knowledge thereon, the probability is forced on him, that a like principle will be found here too to obtain.

Recognizing, in a word, the essential dependency of

moral and physical phenomena upon the operation of antagonistic forces, the probability becomes established, that antagonism would be found essential to the phenomena of the physiological world; and this probability becomes augmented almost to a certainty, when he further reflects that the physiological is placed as it were a mean between the two other natural kingdoms; that is, that from the objects of the physical are formed all the objects of the physiological world, while the physiological alone furnishes materials for a moral creation. Is not then the probability strong, that a principle found essential to the phenomena of the extremes will be found to be equally essential to those of the mean?

But, secondly, let us inquire how far experience confirms this probability.

Among the earliest of the phenomena which arrest the attention of an inquirer into physiological operations, is the condition of motion in matter, with which he finds himself to be everywhere encountered; and recognizing therein an effect of some operative agent, he feels it incumbent on him to endeavour to trace observed results to their cause. In the inanimate world, the natural philosopher, having learned that ponderable matter has been endowed with no inherent power of motion, and at the same time perceiving that such matter moves, has been taught to inquire for inert matter's mover, and to this, whether ascertained or undiscerned, he has applied the term Force. Some agency, research has convinced him, is essentially in operation for the production of every existent motion in inert matter. Some agency is equally essential to stay that motion—once produced. To all such agencies—alike to the originators and stayers of motion—he has applied the term Force.

So, too, in the living world, the physiologist regards it as of necessity appertaining to his province to inquire into the cause of those motions and resistances which he finds to be essentially and peculiarly vital. But as his intercourse with vital operations becomes more and more extended, he soon learns that his mind can form no idea derived from observation regarding vital activity, which is not essentially associated with that of matter in motion. His experience of living matter points to molecular movements as an inseparable, an indispensably essential attendant thereon. The moment matter lives, he sees its elements in motion; this motion he sees continuous, while the matter is living; and when the elements cease to move, the matter no longer manifests life.

But whence is produced this perpetual motion?

Again, let us reflect on the results of our experiences as being the most rational means of reaching a satisfactory reply. Our experience of the laws by which motion, universally, is regulated, has taught us to regard it as an impossibility that matter could, in accordance with its existing constitution, be continuously moving within defined limits of space, except it be as the result of the operation of opposing or antagonizing forces.

We have learned experimentally, that matter once put in motion by any force whatever, moves constantly in one uniform and undeviating direction, and must, if uncontrolled by some antagonistic force, escape beyond any circumscribed limits of space. But we have also experimentally learned that, as the result of antagonizing forces, we may have motion continuous within the most circumscribed limits. Resultant, we see, on their antagonistic—namely, their impulsive and centripetal forces, the planetary move-

ments are continuous within limited space. Resultant, we conclude, on *some* two antagonistic forces, are those molecular movements which we see to be continuous during vital manifestation, within the most circumscribed limits our minds can conceive. Conducted then, as a result of experimental reflection, to a conclusion corroborative of our preconceived conjectures, can we withhold our assent to the fact, that a necessity exists for the operation of antagonizing forces, for the production of the phenomena of active vitality. And what are these forces? With one we are familiar under the appellation—chemical affinity. To the other, namely, to that great power which, during the struggle of vital activity, antagonizes with chemical force, we would apply the terms—organizing agency.

And though impenetrable clouds may ever shade the *nature* of such agency from view—though veiled in such obscurity as to set at eternal defiance the wildest flights of ambitious and aspiring man's imaginings, the essential character of this mysterious influence or force may still elude most vigilant research. Though, as to us appears, search for such essence be at variance with a rational philosophy; still it is by no means, we conceive, inconsistent with a well-controlled intelligence—watching the effects of this agency on the matter with which it is associated, and viewing as the legitimate objects of philosophic inquiry, the nature of the relation between distinct classes of phenomena and distinct conditions of matter, when such phenomena and conditions have been found invariably synchronous to seek, with no irrational grounds of hope for success, some insight into the connection between the cause and the effect. It is thus, we conceive, that its recognition as a fact suggests as a rational inquiry—*why*

this agency exists dormant in matter in which it is known to reside, till aroused into activity by some agent for such function endowed? Its recognition as a fact suggests, as a rational inquiry—*why* the activity of this principle has alone been found in connection with matter, *while* that matter is in the action of chemical transformation? And its recognition as a fact suggests as a rational inquiry—*why* such activity demands, during the period of its manifestation, the presence of matter distinct from that within which it lay dormant, till aroused to activity as chemical transformation commenced? In a word, their recognition as facts at once suggests as rational inquiries—*why* air, food, and molecular transformation have invariably been found the inseparable accompaniments of all vital manifestation? These, which as facts are placed so conspicuously as to be beyond all controversial reach, we regard as among the legitimate objects of physiological research; and it is upon a rational reply to inquiries such as these the foundation of a rational physiology can, we conceive, alone be constructed.

At such reply it would now be our wish to make an effort, but first we must return to the application of our analogy.

If, having made ourselves familiar with inanimate creation, with its atoms, their compounds, its worlds and their systems,—if, having learned of its attributes and laws, it were announced to us that some researcher in science, having recognized a new species of creation, having seen matter under aspects hitherto unobserved, had attained to the discovery of a new class of compounds—of compounds possessed of symmetrical form—should we not, making analogy the guide of our reason, be led to attribute this

new class of compounds to the operation of their attributes, general and specific, in an hitherto unrecognized or NEW CLASS OF ATOMS.

Such experimental researcher is Mankind at large, experience presents all with this new class of compounds in the varied departments of an organized world.

Reflection, guided conjointly by analogy and experience, suggests to us the probability of the following opinions, namely:—

1st. That as all inanimate creation, so far as our researches can reach, is constructed of ultimate atoms of a limited number of distinct species of inanimate matter, variously united and combined with each other—so is all that portion of animated nature, to which our inquiries can extend, constructed of ultimate atoms of distinct species of animating, or, as we would call it, organizing matter, variously united and combined.

2nd. That as on the inanimate atoms were impressed attributes general and specific; the former to constitute them what we designate matter, the latter to vary that matter in kind—so, on the animating or organizing atoms were impressed attributes general and specific; the former to constitute them what we designate organizing, the latter to vary the organism in kind.

3rd. That as the activity and arrangement of the objects of inanimate creation have been made dependant on their intimate connection with the general agencies or forces called gravity, caloric, and electricity—so, the activity and arrangement, or, in other words, the life and organization of the objects of animated creation have been made dependent on their connection with a general agency or force, which we have called the organizing agency.

4th. That as, in the inanimate world, we perceive that certain inanimate atoms of distinct species of inanimate matter, impelled by their specific laws—laws of an inert chemistry aggregating unto unity—gave being to attributes and properties which were hitherto unseen; in a word, gave existence, by union, to a new though compound species of inanimate matter, within which compound each distinct species performs an essentially important though distinctive part; while, by their new specific attributes impelled, we have seen aggregated atoms of such new results assume the symmetrical arrangement of a crystal form—so, in the world of animation, certain organizing atoms of distinct species of organizing matter urged into union by their specific laws—laws, it may be said, of a *living* chemistry, give thereby being to a new result; in a word, give birth, by union, to a new though compound species of organizing matter, within which compound each distinct species of organizing atom performs an essentially important though distinctive part; while, by their new specific attributes impelled, aggregated atoms of such new results complete the symmetrical arrangements of all animals and plants.

But, perhaps, we should explain somewhat more explicitly what we mean to imply by the term Organizing Atom. What we design to convey is, that as evidence supports the opinion that at the creation of the inanimate universe an omnipotent fiat called mineral matter into being, in the form of minute indivisible particles, called mineral atoms; which mineral atoms, though limited in the number of their species, constitute, by the operation of the attributes impressed on them at their creation, the countless multitude of distinct forms of mineral matter found in

the inanimate world, as also the harmonious arrangement now recognizable throughout inorganic creation—so it will be our effort to adduce evidence in support of the opinion, that at the creation of the world of organization, the same Divine power called organized matter into being, in the form of minute indivisible (that is, physiologically indivisible) particles, which we would call organizing atoms—which organizing atoms, though in all probability limited in the number of their species, have constituted, by the operation of the attributes impressed on them at their creation, that vast aggregate of distinct forms of organized matter which decorate with living loveliness an animated world, as also the harmony of arrangement visible throughout all organic creation. Each mineral atom is simple, that is, composed of but a single species of mineral matter. Each organizing atom is, we conceive, compound, that is, composed of a (it may be an inconceivably minute) combination of several distinct species of mineral matter, to which combination, at the atom's creation, was imparted the organizing agency to constitute it an organizing atom. This agency, by antagonizing with the specific attributes of the atom's component constituents, retain them in a relative position distinct from that which would result from the operation of their chemical laws; while the function of each atom is, we conceive, to impart (on the distruction of the antagonistic equilibrium) the organizing agency to other components. We say, the organizing atom is composed of several distinct species of matter; but though anatomically (for it is not chemically) compound, it is, notwithstanding, physiologically atomic or simple. Each mineral atom we have seen to be under the control of but two classes of attributes, namely, those we have

called its laws, general and specific; but each organizing atom is, we conceive, influenced by four distinct classes of attributes, namely, the attributes of its components, or inert matter's laws; and those attributes peculiar to it as an organizing atom, or, in other words, its organic laws, general and specific. And as on the inanimate laws, general and specific, which control the operation of mineral atoms, are constructed our sciences of physics and chemistry; so, in the organic laws, general and specific, which regulate the action of organizing atoms, we recognize the objects of physiological research.

We would now endeavour to place these opinions in the position of probable facts. Our first argument in their support is deduced from the analogy already referred to. Secondly, we would observe, that on the recognition in natural operations of an ultimate result surmounting a series of subordinate contributants, the mind yields an unreluctant assent to the fact, that the design in the creation of those contributing elements was the production of that ultimate result. The existence, for example, of an organized world, constructed of elements of an inert creation, of sentient beings formed of insensible matter, lays claim to our acquiescent consent to the truth, that such matter received its existence and laws as contributants to the organized world; that is, the design of the great and beneficent Giver of Good being a creation that could "taste of His goodness," the end for which chemical and physical laws were impressed on earth's matter was the production of animal life. Here, then, recognizing the necessity for the operation of inanimate matter's laws, for the production of organic phenomena, we are naturally directed to the inquiry, wherein does that necessity consist?

By the term organization, we understand a definite relative arrangement in the position of a plurality of objects. We see such arrangement conferred on inanimate matter by the objects of the vegetable world. There are but three conditions in which we can contemplate an organized structure, namely, during the period of its becoming organized, or while the process of its organization is in progress; in the organized condition, or when that process has been completed; and, thirdly, while passing from the condition of organization, or during the period of its disorganization or decomposition. That the molecular constituents of all organized structures, while in the organized condition, bear towards each other, in their relative positions, an arrangement distinct from that which their attributes as inanimate elements would constitute, is a fact which, (though contradicted by some, and there are few facts which are not,) is so generally, indeed almost so universally acknowledged, as not to demand from us, here, demonstration. It cannot, then, be while in the organized condition, or during the process of that condition's construction, that the chemical attributes of the components of organized structures exhibit their active operation; and must consequently be while passing from the condition of organization, or during their disorganization or decomposition. Hence, then, we arrive at our second conclusion, namely, that the disorganization, or decomposition of organized structures, forms an essential part of organic phenomena. Of the truth of these conclusions our experience of organic operations furnishes us abundantly with corroborative evidence.

When we see the seed of a vegetable conferring organization on inanimate elements, the propriety of calling that

seed an organizing agent will not be questioned. Let us contemplate such inanimate elements respectively in their three distinctive conditions, that is, while exposed to the influence of its organizing agent, or at the period that they are receiving organization; secondly, when that process has been completed, or when these elements have themselves become an agent capable of conferring organization, that is, when they exist in the form of a vegetable seed; and, thirdly, when they are discharging their function as an organizing agent, that is, when conferring organization upon other inanimate elements. Unless organization and disorganization be one and the same thing, it cannot be during either the first or second period that chemical transformation takes place, and, consequently, must be during the third; and hence, we are conducted to the following conclusion, namely, that during the period it is conferring organization on matter, the chemical attributes of the constituents composing an organizing agent, cause that agent's disorganization or decomposition, that is, it then parts with that (be it of what nature it may) which had been the cause of its own organization.

Organizing agents can be composed of but two classes of constituents, namely, ponderable and imponderable; or, as they are called, material and immaterial. We see organizing agents in the vegetable form conferring organization upon unorganized ponderable constituents, thereby converting them into an organized vegetable, and manifesting through them vegetable life. We see organizing agents in the animal form augmenting the organization of *the same* ponderable constituents, raising them in the scale of organization, thereby converting them into an organized animal, and manifesting through them animal life. We

see the same ponderable constituents, when animal life has ceased to be manifested therethrough, return to their original unorganized condition; again to become vegetable, from which to be reanimalized, and a second time pass to the unorganized state. Can we doubt that such process has been continuous from the creation of organizing agents till now? But what has been imparted by the vegetable to the unorganised ponderable constituents, to constitute them an organized vegetable? What by the animal to the organized vegetable, to constitute it an organized animal? Not the ponderable constituents of the organizing agent, for these we have traced from the unorganized world, consequently that imparted must be imponderable; but in our last deduction we concluded, that what was parted with by the organizing agent, was that which had been the cause of its own organization; and consequently, the general conclusion at which we arrive is, that organizing agents, when conferring organization on matter, impart thereto an imponderable principle, which had been the cause of their own organization, (called by us the organizing agency or influence) on parting with which they no longer retain the organized state, but are reduced to the condition of chemical compounds; while the matter to which they have imparted the organizing influence, is thereby elevated to that position in the scale of organization, which the organizing agent had originally held.

Would it not, from the foregoing considerations, become apparent that, upon the supposition that organizing atoms exist, the function we have assigned to such atoms is correct?

We shall now endeavour to show wherefore it is we conceive there is a probability that organizing atoms do exist, and shall again, as our first argument, appeal to the analogy

already advanced. Our second argument, in support of the probability of organizing atoms, is derived from the geologic records of earth's history during its ages that have passed. By their revelations, we have disclosed to us that, at various epochs in time, distinct species of organized beings have, in earth's two great organic domains, flourished for a period and passed from existence, giving place to an hitherto unrecognized species; while we know of no physiological theory, which satisfactorily accounts for a fact that admits of simple explanation on our organic atomic hypothesis. Thirdly, we regard the existence of entozoa as strongly in support of our views. And fourthly, the phenomena of an equivocal generation. The application, however, of such arguments will become more intelligible when our views have become more developed; and we shall consequently postpone their consideration till we have entered somewhat more explicity into what we conceive to be the nature of the so called organizing atoms. Leaving, therefore, for the present, these and the like considerations, we shall now proceed to another line of argument.

To man, were he untutored either by experience or history, it would perhaps appear probable that when Deity pleased that creation should be, the fiat would have gone forth for its instantaneous completion. But how truly are we told that " His ways are not our ways." It is scarcely possible to peruse the beautifully simple statements of the patriarchal historian, as in the beginning of the sacred volume he records the order of creation, without being struck with the progressive steps in the advance from its commencement to its completion—from the period of chaos to that in which God is said to have " rested from His work." Original creation is but the type of all subse-

quent creations, and the same law of progressive advance is conspicuously seen ever to prevail, in the fulfilment of the first divine injunction, "be fruitful and multiply." Indeed there are few truths in physiology more calculated to arrest the attention, even of the mere casual observer of natural phenomena; or which, when recognized, strike him as being more forcibly conspicuous, than the gradually progressive nature of the advance, in every transition from an humbler to a more elevated degree of physiological developement; no example does he observe throughout wide nature's range, of a great transition in developemental results having occurred abruptly; nor is his recognition of this law confined to a single division of nature's organized dominions: it is a truth equally forced on him in her distinctive departments, in her kingdoms respectively of vegetation, of animal existence, and of mind. He sees it to be in attendance alike upon structural developement and functional exercise of structure. He sees the forest's stateliest pride, as rearing its magnitude toward heaven, and spreading a luxuriant sheltering-place for feathered tribes, pass but by slow progressive steps from acorn's littleness to oak's colossal size. He sees his own corporeal being reach full developement by like degrees. He sees the giant genius which could guide to worlds unseen and central sun, grow to its greatness by degrees, from infant's imbecility to child's simplicity, and thence from boyhood's gathering strength and youth's intelligence, to man's profound maturity—to Newton's mind. Nay, more, even the moral culture of that mind, be it for weal or woe, he sees is placed in close subjection to the same unbending law of slow progressive change. "I have fed

you," says the inspired apostle, "with milk and not with meat." While his knowledge of depraved man's mode of mind led Rome's observant satirist to say, "Nemo repente turpissimus fuit." And if such law force itself on the recognition of nature's mere casual observer; if it be placed in conspicuous relief before the view of the least inquiring of mankind, how augmented, how vastly augmented, becomes the force with which such law is disclosed to the vigilant investigator of nature's secret phenomena? how absolutely universal, how immutably invariable is that law found to be by the physiologist? Were *he* told that some surpassing product should result from humblest means; that rough materials of an inert world should be transformed to structures exquisitely wrought and delicate; that dust of this earth should give its form to that wherein resides man's intellect, to that through which he sees, and feels, and thinks—the resting place of his Creator's breath; might he not well expect to find multiplied, vastly multiplied, the graduated steps through which transition of such wondrous kind had passed. Nor is it otherwise. An organism of the earliest kind was formed to push earth's elements but slightly from their inert form, and give them humblest life; these by a second are advanced, and by a third urged further forward still. But we anticipate.

We have defined organization to be a definite relative arrangement in the position of a plurality of objects, such definition being, for our purpose, to use the language of logicians, sufficiently adequate and clear. All matter that has been so definitely arranged, or, in other words, every organized structure, having been organized with the design of its performing some definite function, must ob-

viously possess properties for that function's fulfilment, distinct from those which would exist in the product of the chemical union of its components. Let us call the functions peculiar to organized structures physiological; and the more remotely the physiological properties of any such structure are removed from the physical attributes which would result from the chemical union of its components, the more highly organized the structure may be said to be. How numerous are the degrees of organization in this acceptation of the term "degrees," presented to us in the two departments of the organized kingdoms? What vast variety is there in their degree of physiological developement, in the varied structures intermediate between earth's first formed vegetations, whose organization but just removes them from inanimate matter, and the most highly elaborated products formed within the organism of man. And how are these degrees of organization conferred? We would reply, that all experience as well as all analogy oblige us to say, *by a graduated scale of progressively advancing organizing agents*, which agents we analogically call *organizing atoms*.

The first link in the great chain of organic or organizing atoms, we conceive to be the humblest of the organisms existing in the simplest vegetation, such organisms as are earliest in departure from mere inanimate matter—the last link which to us has as yet been made known—the most elevated of the organisms found in the complex organism, man; we say, has as yet been made known, for the last link in that great chain may possibly, we conceive, for centuturies still remain dormant. The function of the first, we conceive, is to confer organization and life on inanimate matter, to elaborate into an organized product the inert

constituents of earth; of the last, to augment organization and life in matter that has already been organized—to elaborate into a still more highly organised product matter that has already been highly elaborated; and between these extremes, organizing atoms for the elaboration of all intermediate degrees of organization must, we conceive, of necessity exist.

We called attention, when observing on the general forces which give motion to inanimate matter, to the necessity we conceived there to exist for the operation of what we called that matter's reciprocal or stimulus, before the action of such forces could be manifested. Our object in so doing was to point to a similar necessity which we regard as existing, for the operation of an analogous reciprocal or stimulus, before the action of the analogous general force, the organizing influence, can manifest its active operation. We would now direct attention for a moment to what we would call the law of reciprocity, or, more correctly, (if we be allowed such expression,) the law of specific stimulation, which is equally conspicuous with that of progressive advance. Gravity is, we conceive, not more universally a force operating through matter, than is this law of reciprocity or stimulation—a law universally applicable to operative forces. Let us be understood; what we desire to convey is, that experience presents us with no example of a force operating through matter as a cause of manifest results, that has not been made of necessity, and essentially dependent for that manifestation on the operation of something distinct from the matter through which such manifestation takes place. Such we have seen, in the inanimate world, to be the case with gravity, caloric, and

electricity, and such is obviously equally true of inanimate matter's specific laws, or of the forces called chemical.

A little reflection will show that this law extends with a like universality over the entire of the organized world. We see the seed, which for centuries has lain inactive and indolent, spring instantaneously into action when that something is present. We see the function of the contents of the animal ovum for ever undischarged, unless by its stimulus called into action. But, not to multiply examples, how perpetually in our own persons are we told of this law? How completely has our nervous system been made subservient thereto. We find our sentient nerves, whether those of special or of ordinary sense, have each its appropriate agency for calling its function into action. Does the organ of vision discharge its function in the absence of light? Is that of hearing in activity when no vibrations exist? Do not the olfactory and gustatory nerves require something specific in matter's construction, without which smell and taste were for ever unknown? And does not the ordinary sense of touch require contact as its excitant? Nor is this law confined to the sentient portion of our nervous system, but is in equal force with respect to our motor apparatus, at least that portion of it known as the voluntary nerves. Volition, and volition only, can in a normal condition of the organism call into active operation the function of the voluntary nerves. Volition is then obviously the normal excitant or specific stimulus of the voluntary nerves. All such excitants will illustrate what we now mean to convey, when we employ the term reciprocal or specific stimulus, namely, that, be it of what nature it may, which for each is capable of calling into operation its functional action. And we trust, as we

proceed, we shall be enabled to show that the involuntary portion of our nervous system has not been exempt from this law.

If, then, this law of reciprocity or of specific stimulation be universally applicable to all operative forces, we should expect to find each organism constructed for conferring organization; that is, each link in the chain of our organizing atoms must be provided with some distinct specific stimulus, which is capable of calling into operation its functional action. In other words, before any organizing atom can confer its organizing agency upon matter, that atom must be exposed to the influence of its own specific stimulus, so that for each link in the great chain of progressively advancing organizing atoms, we must look for an appropriate stimulus; constituting, collectively, a corresponding chain of progressively advancing excitants or specific stimulants. That such is the case it shall be our endeavour to show; and, with this view, we would now call attention to the contemplation of life in its simplest process; that is, as it is manifested by the humblest of vegetations, or by the first or simplest link in our organizing chain; and, before doing so, we would, in the first place, premise that, as in the inorganic or inanimate world, having acquired a knowledge of the principles which regulate the operation of the general forces, gravity and caloric, as they control the physical action of an individual particle of any species of matter, we may predicate the same as their principles of operation on all inanimate matter universally; so, in the organic world, or world of animation, if we can attain to a knowledge of the principles which regulate the operation of the great general force, the organizing influence, as it controls the physiological action of

an individual organizing atom, we may predicate the same as its principle of operation on all the organizing atoms throughout organic creation.

Let us, then, retaining this reflection in the memory, contemplate life in its simplest process, or as it is manifested by the first link in our organizing chain; that therefrom we may collect *the general laws* which regulate the manifestation of *all* earthly life. A microscopic granule formed of carbon, oxygen, hydrogen, azote, and potassium, (or the like) combined in definite proportions, and so relatively arranged as to constitute the condition called organized, is all we can be said to know as to the material composition of that atom. The arrangement in the relative positions of those constituents is, as we have seen, essentially distinct from that which their own specific attributes as inanimate matter would bring about; while it was, as we have endeavoured to show, the organizing influence originally conferred at its creation upon that atom's first parent, and at length, through successive generations, propagated to it, which constituted this distinction in the arrangement of its components. On the constituents of that atom are operating two distinct and opposing forces, each, as it were, energizing to exercise its sway; the organizing agency retaining them in the condition of organization; their specific attributes, or, as it is called, chemical affinity, struggling to render them inorganic. So long as these two antagonistic forces balance each other's action into a condition of equilibrium, there will obviously be no manifestation of the action of either; and this organizing atom, though known to contain the organizing agency, can exhibit no active properties in consequence thereof, which would distinguish it from ordinary

inanimate matter. We can thus understand how the organizing agency may remain dormant in matter in which it is known to reside, till aroused into activity by such means as are adequate to that end. And what are those means, we at once naturally inquire? As the organizing influence cannot reside in matter which is not thereby rendered organized, the destruction of the organization of the organizing atom must give emancipation, and consequent activity to the organizing influence. Then, and not till then, can the operations of this agency become active or manifestly apparent. Destroy, then, the organized condition of the organizing atom, and the result will at once be that the organizing influence or agency must be set free. No longer *dormant* in the matter in which it is known to reside, that matter will *now* manifest properties markedly distinct from those of inanimate matter; it will now exhibit the phenomena of active vitality. But how can the organized condition of the organizing atom be destroyed? Obviously, by either increasing the chemical, or diminishing the organizing force, or perhaps most efficiently by both.

In what way could the chemical force be more effectually augmented, than by presenting to the atom a chemical agent, which had for some of its constituents an extraordinary affinity? That chemical agent we have already seen in oxygen gas, and the constituent of the organizing atom is the alkaliginous metal. And in what way could the organizing agent be more effectually diminished, or, which is the same thing, withdrawn from the atom, than by presenting to such atom that which is capable of involving it in, as it were, a reciprocal or interchanging action; in a word, presenting to it its own specific or ap-

propriate stimulus? But what that stimulus is, we shall now proceed to inquire. What, we would ask, are the conditions found most favorable for effecting chemical union? One we have seen to be nascency in the chemical elements; another is well known to be the presence to those chemical elements of certain conditions as to fluidity and temperature. And what, we would inquire, are the circumstances under which vegetation, in the simplest plants is seen to take place? They are the presence to the chemical elements, namely, to the component constituents of the seed and to the oxygen of the atmosphere, of certain conditions as to fluidity (viz. moisture,) and temperature, (constituting, if nascency in the elements should also be present, the conditions most favourable for chemical union,) together with the essential presence, *in the inanimate or unorganized form*, of matter of the same species as those of which the seed was composed. Here then we have disclosed to us, what it is which constitutes the specific stimulus of the first or simplest link in the organizing chain, namely, the unorganized or mineral matter upon which it is about to confer organization. Here, too, we have suggested to us what it is which must constitute the specific stimulus of each succeeding link of that chain; namely, that for each upon which each was destined to confer organization—that for each upon which each has, from its construction, been adapted to exercise its function of elevating it one progressive step in the great scale of organization. Thus, then, as we have been led to believe in the necessary existence of a chain of progressively advancing organizing agents or atoms, whose function is *to confer* organization; so, too, we believe in an equal neces-

sity, before that function can be fulfilled, for the existence of a corresponding chain of progressively advancing organized structures, whose function is *to receive* organization, and which were designed and adapted for calling into operation the function of the organizing atoms. Between these two chains, at corresponding positions respectively in each, such natural reciprocity we conceive to exist, that when brought (conjointly with the necessary contingency to the atom of increased chemical action,) within the sphere of each other's reciprocal operation, an interchange of action, as it were, takes place between them, and each discharges its functions respectively—the atom of imparting, and the reciprocal or stimulus of receiving, the organizing influence. The first link in the chain of atoms is the simplest of vegetations. The first link in the chain of stimulants is mineral matter. The last link in the chain of atoms may be the most highly organized organizing atom existing within the complex organism, man. The last link in the chain of stimulants is some highly elaborated organized product, which may arouse that atom to the discharge of its functional operation—some highly organized structure upon which the last atom can confer an increased organization. And as, when directing attention to the stimulus which was capable of calling into operative action the caloric which had been latent in matter, we solicited permission to call such stimulus *that which was below such matter in the scale of calorification;* so we now see that the stimulus which is capable of calling into operative action the organizing influence which had been latent in the organizing atom, is *that which is below such atom in the scale of organization.* The first link in the organizing chain is but re-

moved from inanimate matter—the stimulus of that link is *inanimate*. But let us proceed.

The moment the first link in the organizing chain, or the simplest species of organizing atom, is (in conjunction with atmospheric air and the requirements as to temperature and moisture) brought within the sphere of the operation of inanimate elements of the same species as those of which the atom itself is constructed, an interchange, as it were, of action takes place between the atom and the inanimate elements, the effect of which is, as though each had imparted to the other those forces upon which the relative position of its own constituents had depended. In the organizing atom, when exposed to the influence of such inanimate elements, the equilibrium in which its antagonizing chemical and organizing forces were maintained, must, by the attraction exercised for the organizing influence by those elements (as the reciprocal or stimulus of the atom,) sustain a disturbance. If, then, at the moment that the balance of equilibrium between these two forces has been disturbed, atmospheric oxygen so act upon the component constituents of the organizing atom, as to augment the intensity of their chemical action, the result must be that the chemical force of the components of the organizing atom will obtain the complete mastery over their antagonizing force, namely, the organizing influence; and the elementary constituents of the organizing atom being at the moment all in the condition of nascency, the final result must be that these constituents will eventually be reduced to the condition of inanimate chemical compounds. In such compounds it is impossible that the organizing influence can reside; and now, at once invited and forced from connection with the components of the organizing atom, it will

struggle with the specific attributes of the inanimate elements, till, having obtained over them the mastery, it has ranged those elements in the relative position which constitutes organization, till, having elevated them to the condition of an organized mass, it has formed a structure within which itself may reside. In a word, emancipated from its latent union with the components of the atom, no longer kept dormant by the control of those components' specific laws, it now, unfettered, in obedience to the laws of its nature, to those laws which we have seen regulate the operation of all general forces, radiates centrifugally and in every direction, ranging the stimulus round the atom in the form of an envelope surrounding a nucleus. Do we not here, as a result of the operative action of the first link in our organizing chain; do we not here, as a product of the functional operation of the simplest conceivable of vegetation, recognize the physiologist's far famed "*nucleated cell?*" And do we not also here recognise a rational reply to our original inquiries,—*why* air, food, and molecular transformation have invariably been found the inseparable accompaniments of all vital manifestation? But let us view somewhat more closely the progressive steps of this process, in order to ascertain, if possible, how the organizing atom eventually disposes of its reciprocal or stimulus.

The first effect of the operation of the organizing influence upon the inanimate elements, must obviously be to convert them into an uniformly organized mass, which mass must assume somewhat of the form of an hollow sphere. The intensity, or the degree of concentration in which the atom originally held the organizing influence, must, by this process, have sustained a diminution; a part thereof being of necessity expended in the construction of

this organized spherical mass. At this stage, then, of the process, (or obviously at some stage) the organizing atom and its reciprocal or stimulus occupy the same position as to their degree of organization, or as to the degree of concentration in which they hold the organizing influence; with this distinction, that they are proceeding in vertically opposite directions in the process of organization, the atom imparting what the stimulus is receiving. What, then, are the further or advanced stages of this process? What ultimately becomes of this organized mass? We believe it to be appropriated in three distinct ways. One portion thereof *we see* to assume the form of a membraneous structure, which constitutes the capsule or envelope of the nucleated cell: a second portion we believe to remain as *a residual product*, the appropriation of which will be found to be dependent upon a contingency: and from out the third or remaining portion of that organized mass, the organizing atom, concentrating thereon the full amount of its now impaired energy, expending thereon what remains of the organizing influence, and discharging therein its last act of vitality, remodels its type, and resigns its own life. Here, then, we have as the product of the functional operation of our first link, or the simplest conceivable of vegetations, two new structures and the type of the original organizing atom produced.

Let us for a moment contemplate this process; for humble though it may appear, there is, as we conceive, therein portrayed to us the type of everything on earth that lives; yes, every thing—not even is excepted man—even proud man, who, in his lofty progress through the world, tramples to nothingness, in thoughtless scorn, myriads such like; even vain man is but himself a multiplied re-

semblance of this unpretending type. But with what reflections does it fill the thoughtful mind? With none, perhaps, with greater force, than, in the emphatic language of the sacred pen, that "in the midst of life we are in death." Death! Wherein consists this solemn sounding term? Has death—man's final foe on earth—been made companion of his life? It is even so; nay, more, death is essentially a part of life. It is the transit of the organizing influence from the organizing atom which causes that atom's death. It is the transit of the same organizing influence to that atom's type which gives to that type its life. But it is *during*, and alone during such transit, that conjointly the two atoms live. Abandoned by the organizing influence, the elements of the old atom, now unfettered by opposing forces, become amenable to inert matter's laws—in a word, become inert; and this it is which constitutes its death. Controlled by the same organizing influence, the elements of the new atom assume the organized condition; in a word, become possessed of and adapted for imparting life; and this it is which constitutes it an organizing atom; that is what gives it life. But as it is while, and only *while*, the parent atom is resigning that influence which caused it to be an organizing agent, that such atom can be said to be dying; so it is while, and alone *while*, the offspring atom is receiving the same organizing influence, that it can be said to be living: and thus are two essentially distinct and opposite processes, of necessity, concerned in producing the phenomena of active life; are, of necessity, in operation for the production of what we imply when we say of a thing, "it *lives;*" and thus, too, becomes apparent how death is essentially a part of life, how "in the midst of life we are in death."

The result of these processes being the organization of matter which was hitherto unorganized, we would define living to be—the *act* of receiving the organizing influence —the *act* of being elevated in the scale of organization.

But there is another reflection forcibly suggested by the contemplation of this process, and it is this. If such be a correct representation of the process of organization, the period during which life can be manifested by organized beings must, generation after generation, be gradually becoming shorter and shorter, until at last organized beings shall cease to exist. For we have seen that the organizing agency, as it is being propagated from parent to offspring, is gradually sustaining a diminution in its degree of concentration; a portion thereof only of that which was possessed by the parent being transmitted by that parent to its offspring or type. Do not the records of an antediluvian world corroborate this suggestion?

But it may be asked, with what design could this atom have been created? Wherefore could this little granule have been formed to give being to its type, and, having done so, to retire from existence? What end in nature can possibly be fulfilled by the continuous renewal and destruction of a structure of such apparently trifling importance?

The reply to this question conducts us to the consideration of the nature and function of the next atom in the scale of organizing atoms, of the second link in the great organizing chain.

We observed, when speaking of the organized mass which was the first product of the action of the organizing atom on the inanimate materials adapted to its operation, that a portion thereof remained as a residual product, the

appropriation of which was dependent on a contingency. By that contingency we meant the presence of the atom about which we now are concerned, namely, the second link in the organizing chain. This residuum, we conceive, bears to the second atom the same relation which inanimate matter bore to the first, that is, the relation of specific stimulus or reciprocal. When, therefore, this residuum and the second atom are, under analogous circumstances, brought within the sphere of each other's operation, an interchange of action will take place between them, analogous to what occurred between the first atom and inanimate matter. The result of which will be, that the residual product will be raised to the condition of an organized mass, one step more advanced in the scale of organization than it had been, till placed within the influence of the operation of the second species of organizing atom. A portion of this mass will, too, be converted into a membraneous structure, which will constitute the second atom's capsule or envelope. A portion will remain as a residual product, whose appropriation will depend on the contingency of the presence of the third species of atom; while out of the remainder the second species of organizing atom will remodel its type.

Let us suppose single individuals of the first three species in succession, of organizing atom, namely, one of the first, one of the second, and one of the third links in our organizing chain, to be so brought within the sphere of each other's action, as to admit of the operation of their specific laws—laws (as before observed,) it may be said of a living chemistry. Suppose, too, that in accordance with those laws, a mutual affinity exists between these three atoms, the result will be, that a union will take place, and

a compound organism be constructed, which will, in all probability, be possessed of something of a symmetrical form.

In such a compound we should naturally expect, that each distinct species of organizing atom should have to perform some essentially important though distinctive part; while the function of all organism, we can scarcely doubt, is to confer organization.

Suppose, then, such compound organism placed in the conditions required for the fulfilment of its physiological functions, (that is, presented with the necessary inanimate elements in conjunction with atmosphere, and the essentials as to moisture and temperature) what should we expect to result? We should expect that a reciprocal or interchanging action, as it were, would, in the first instance, take place between the first or simplest of the three atoms, and the inanimate elements; the result of which would be, that the atom would elaborate the inanimate elements into an organized mass; that out of this mass it would construct for itself a membraneous envelope; would furnish materials which could call into operation a reciprocal action in the second; and finally, would remodel its type: and thus, having completed at the same time its function and its organic existence, it would be reduced to the condition of inanimate matter. We should expect that a reciprocal or interchanging action would, in the second instance, take place between the second species of atom, and that portion of the mass organized by the first, which was destined to be appropriated to that purpose, namely, its residual product; the result of which would be, that the atom would elaborate the organized mass into a mass still more organized; that out of this mass it would construct for itself

a membraneous envelope—would furnish materials in the form of a residual product, which would call into operation a reciprocal action in the third, and finally, would remodel its type; and thus having completed at the same time its function and its organic existence, it, too, would be reduced to the condition of inanimate matter.

And so of the third; it, in like manner, having been called into reciprocal action by that portion of the organized mass elaborated by the second, which was destined thereto, and having produced results in all respects analogous to those effected by the second and first, would, on the remodeling of its type, have no longer organic existence. But what would be the general result of such process ? It would be obviously this: we should have the compound organism, as it proceeded in the discharge of its physiological function, gradually becoming augmented in its bulk or dimensions, and as gradually giving developement to new species of structure. We should, in obedience to the specific attributes which originally united the three atoms into something of a symmetrical form, have these new structures, according as they became developed, definitely and symmetrically arranged. We should have three distinct species of membraneous envelope, which may, as we shall hereafter see, become, according to contingent circumstances, tubes, fibres, &c. We should have three distinct organized masses, or, in other words, what we shall hereafter have to call three distinct species of secretion, nerves, muscles, &c.; and finally, we should have the three types of the original three atoms, (possessed as they must be of the same specific attributes as were possessed by their parents, and consequently urged thereby into the same form of union,) constituting an embryonic

representative of the original organism, and in all respects identical to what that organism had been, antecedently to the commencement of its physiological function, and adapted, under similar circumstances, to give developement to a similar train of results.

Let us again pause to contemplate in their wondrous minuteness these atoms collectively in extreme limits of space. Let us, reviewing this aggregate unity—regarding these three atoms harmoniously blended into one—behold in the analogue of creation's* vast organized structure, an organism of surpassing simplicity and triflingly compound; simple, yet at the same time harmonious; its elements constitute the humblest of organisms; its integral parts form distinct kinds of structure. Those elementary constituents, namely, the three simplest of atoms, by their relative arrangement, constitute this organism's organization. Those integral parts, as the products of the elements, give to animate creation's minute organism some symmetrical form, (while to each, alike to the element and the integral, is assigned the exact position in the organization it shall occupy; to each, as well to the atom as the aggregate, the exact limits within which through that organism its functions may range)† and all are controlled to the harmony

* Page 9.

† We have included the above paragraph in a parenthesis, in order to observe, that we consider it only partially true that the relative position of the organizing atoms, and of their products, is in a complex organism, dependent upon the great *general* organizing influence or agency. Their relative positions we conceive to be chiefly dependant upon the operation of the *specific* attributes of those atoms; but are, as we regard it, so far influenced by the general organizing agency, as is the relative position of the elementary constituents of an inanimate crystal influenced by the caloric, &c. with which these constituents are known to be associated.

of unity, and kept in constant activity, we may now say vitality, by the same great organizing influence emanating from the centres of all.

If then such be what we should expect as the result of the combined action of individal atoms, selected from the first three species of organizing atom, what might we not anticipate from an indefinite augmentation, alike both of the individuals and the species? Might we not, by the progressive addition indefinitely to this little organism, of species after species of organizing atom, multiplying and varying, as circumstances may demand, the individuals and varieties each shall supply; and thus adding structure to structure, and secretion to secretion, giving existence to an indefinite variety of compound or aggregate organisms. Might we not thus be soon enabled to number as many species, varieties, and individuals of living symmetrical forms as are found to exist in the vegetable world? Nay, might we not still, extending and varying the species, pass forward through animals even to man; and thus reaching, as it were by synthesis, man's constitution, regard him as but a compound organism, constructed by the aggregation into unity of distinct species and varieties of organizing atoms? And is not this hypothetic synthesis confirmed by an actual analysis? Does not analysis show complexity in man's organization? Do we not find within the organism of man, structures widely separated in their degrees of physiological developement. Will it be denied that organization can alone be imparted by an organizing agent, or that degrees of physiological developement must have been conferred gradually and progressively? If, then, experience prohibits our questioning these facts, does it not become apparent, that within the constitution of man there

must be a variety of organizing agents which differ from each other in their degree of organization?

We have just used the expression, varieties in the species of organizing atom, which may demand from us some explanation. By the term variety, as applied to organizing atoms, we mean to convey, that, from what we see to be constantly taking place around us in the animate world, it would appear that each link in the organizing chain, or what we have called each distinct species of organizing atom, comprises under it various atoms composed of distinct combinations of different species of inanimate matter, individually constituting the variety, and, collectively, the species of atom. All the varieties of the same species, (though composed anatomically of different constituents) must stand in the same position with regard to their own degree of organization, as also to that of the matter to which they are competent to impart the organizing influence. Such being the case, it is obvious that what we have called the residual organized product of the functional operation of any variety, may be competent to stand in the relation of reciprocal or stimulus, (that is, may be competent to call into functional action) any variety of the species of atom next above it in the organizing scale. It would also appear that certain organizing atoms can discharge their physiological function, that is, can confer their own degree of organization upon a compound residual product, that is, upon a combination of residual products derived from the functional operation of different varieties of the species of organizing atom next below it in the organizing chain; or, in other words, a compound residual product, formed by a combination of different residual products derived from the functional action of several varieties

of one species, may stand in the relation of reciprocal or stimulus to some variety in the species next above it. For each of these facts (namely, for the substitution of the residual product of one variety for that of another, and for a compound residual product calling into action the functional operation of an atom) we are furnished with an analogue in the inanimate or mineral world: for the former, in the substitution of one element for another without altering the species of a crystal; and, for the latter, in the triple salts where we see two bases combined with an acid.

In a complex organism, whose period of existence is restricted to confined limits of time, we can well conceive it to be essential that several of its component organizing atoms should, at the commencement of that organism's functional operation, be called synchronously into operative action; while it will be as readily admitted, that for the operation of some of its atoms there may be a necessity for a compound residual product. In these two necessities we conceive we can recognize the origin of distinctions in sex.

By one parent of a vegetable, the various regenerated organizing atoms are, in the form of an ovule, combined into the embryonic representative of its species. By the other, the various stimulants, reciprocals or residual products, required by those atoms in that ovule, which demand to be simultaneously, at fœcundation, called into operative action, unite to form that mysterious compound known to the botanist as pollen.

By one parent of the human organism, regenerated, nervous, vascular, glandular, muscular, &c. organizing atoms, urged into union by their specific attributes, and, by the

laws of organization, deposited in that portion of the human mechanism appropriated thereto, constitute man's embryonic representative in the form of the contents of a Graaffian vesicle.

By the other, elaborations and compound elaborations, of such high organization as may call into functional action all the vastly elevated atoms in that embryo's composition, which, at the instant of conception, must spring into simultaneous operation in their accumulated form, constitute man's regenerative sperm.

In this mystic secretion must be contained every thing the embryo requires on which to manifest its earliest life. This high elaboration must, in a word, bear to the compound and complex organism—the human embryonic type—the same relation which the inanimate elements of earth bore to the first or humblest of our little organizing atoms.

May we not here read a rational explanation of the mode, in which morbid poisons may be propagated through the human family during such prolonged periods of time? How specific disease may be transmitted for ages from parent to child?

A morbid poison is, we conceive, either an organizing atom, which has undergone such modification in its own organization as it is capable of communicating to the type it reproduces, or an organized product elaborated under circumstances which confer on it such abnormal constitution, as it is capable of communicating to the atom to which it stands in the relation of reciprocal or stimulus. Should one such modified atom, or elaborated product, become a constituent of the general embryonic representative, or of that representative's reciprocal or stimulus, the offspring

must obviously partake of that modification. But we would reserve any further observations on the subject of morbid poisons, till we come to treat of inflammation at large.

Have we not also here suggested to us an intelligible explanation of the mode of operation of certain medicinal agents. The alkaloids for example, all of which appear to exercise their influence specifically upon some portion of the nervous system, occupy, in all probability, as organized products, a position in the graduated scale of organized structures, not remotely removed from that of nervous matter generally. Thus morphia, strychnia, quinia, &c. are in all probability, elaborations of the *same species* of organizing atom, their distinctions resulting from each being the product of a different *variety* of that species, while the species would appear to be close to—it may be that it is but one link below in the organizing chain, that atom which presides over the formation of the nervous matter of animals. If such be the case, we could well understand, physiologically, *how* all such elaborations could modify the function of nerves.

And might we not, on this hypothesis, also explain how, at great epochs in earth's history, new species of organized beings may, from time to time, have appeared; how, during those vast catastrophes which geology tells us have so oft laid desolate our world, distinct species of organizing atom, hitherto remotely removed from each other's sphere of operation—too distant to admit of reciprocal interchange —too far separated for their specific attributes to extend their control; might we not, we say, understand how, by some disturbing volcanic upbreak in nature, such atoms, forced within the sphere of each other's mutual action, might, by union, give being to compound organisms hi-

therto unobserved. These, at the next great physical change, may pass again from existence, leaving, as a record that they had been, but their fossil remains.

If such views be correct, we can now see the importance, the paramount importance to all organized beings, of the first or simplest species of organizing atom. In it we recognize the great connecting link between the inanimate and animated world, as it alone can confer organization on inanimate matter; and thus humble though this little atom appeared, on its existence depends the existence of all organized beings. A great and important distinction must then obviously exist between such organisms as have this atom as a component constituent, and those in which it does not exist; between such organized beings as can discharge their physiological function on a surrounding inanimate world, and those which demand for such discharge organized matter. This distinction, we conceive, constitutes nature's grand division of the organized world into the vegetable and animal kingdoms.

If such views be correct, they suggest a foundation upon which to construct a distinctly new science, by pointing to the objects of a true organic chemistry. If such views be correct, it will become a part of the physiologist's research to seek for and classify the various species of organizing atom. It will be his to inquire where affinities between different species exist, their degrees of intensity, and where there is none; and such inquiries he will regard as appertaining as legitimately to his province, as to determine the relative degrees of intensity in the affinity between oxygen and potassium, and oxygen and platinum, belongs to the duty of the ordinary chemist. When he has found that no affinity exists between the first or simplest link and

either the nervous or muscular atom, while the affinity between these two latter is so strong that they never have yet been found separate, he has but learned a fact in organic chemistry, or the chemistry of organization, for which his experience will furnish him with multiplied analogues in the chemistry of inanimate matter.

Inquiries such as these would, we conceive, constitute the science of organic or living chemistry; while researches into the *general* deportment of all atoms alike, as well the simplest or most humble individually and alone, as the highest or most elevated complex or aggregate organism would constitute the distinct science, if we might so call it, of an organic or living physics. These two conjointly would, as we regard it, be comprehended under the science of physiology, commonly so called.

If such views be correct, there is another fact to which we would solicit attention, and it is this:—Should we, in the course of our physiological researches, meet in a complex organism, (such, for example, as that of an animal,) with a residual organized product, which we had reason to suppose was not designed as the reciprocal or specific stimulus of any organizing atom above it in the organizing scale, we should feel it to be incumbent on us to attribute *some* function to such residual product, and would be led to anticipate that such function would in some way have relation to the calling into operative action the function of something in the organism.

That such a residual organized product is found in animals we shall presently endeavour to show; but we would first offer a few words on the application of these observations to the physiology of the human circulating fluid.

CHAPTER III.

THE BLOOD.

On entering upon an inquiry into the nature and character of any physiological compound, one of the first questions which naturally suggests itself is—for what end does this compound exist? Should we be enabled satisfactorily to determine the reply, our inquiries become partially simplified. But if, in addition to our acquaintance with that end, we have, by a pre-acquired knowledge of natural operations, become familiar with the *sole* method nature adopts in the appropriation of her means to the carrying of that end into execution, we obviously have our inquiries thereby rendered considerably more simple. And should the antecedently ascertained requirements be found upon analysis to correspond with the observed condition of the compound, the evidence as to the nature and character of that compound is as conclusive as mathematic demonstration.

If, for example, on entering upon an inquiry into the nature and character of a compound of such complexity as the human circulating fluid, we be enabled, from our antecedently acquired knowledge as to the requirements of our organism, to determine the necessity for the existence of blood, as also its necessary elementary components, we enter upon our analysis of that fluid with the subject in

some degree simplified. But if, in addition to our acquaintance with the requirements of our organism, as regards the nature of the clementary components, we have at the same time become familiar with the sole means nature adopts in the appropriation of those components to the fulfilment of that organism's functions—that is, if we have learned not alone *what*, as to components, our organism demands, but at the same time *how*, as to the arrangement of those components, such demands are fulfilled,—we have acquired an *a priori* acquaintance not only with the composition, but also with the arrangement or construction of our blood. And should our analytic researches correspond with our preacquired knowledge, should our acquaintance (as to composition and construction) with what the blood ought to consist, be corroborated by what it is found to contain, we have, as it were, synthesis confirmed by analysis—the clearest evidence of the composition and construction, and consequently of the character and nature of the blood, that a question of such kind can admit of. While on the other hand, should our analytic inquiries correspond with our *preconceived conjectures*, it would be strong evidence in support of the correctness of our views.

What then, we first inquire, is blood, and for what end does this physiological compound exist? We are told that the great end of the blood is the nutrition of the organism; but such reply removes the inquiry but one step further back, and we ask what is nutrition, and wherein consists the necessity for it? Should the opinions just advocated correspond with the reality of things, this question admits of a simple reply. In accordance with such views, it would appear that conferring organization upon matter

is what is ordinarily called nutrition, and that assimilating, as it is termed, and living are but one and the same thing.

Having in our foregoing observations endeavoured to show, that during vital manifestation there is necessity for the presence of materials to be vitalized, while an equal necessity exists for materials once vitalized to be passing into decay, we at once see the necessity in the living human organism for both such materials *to be constantly in motion;* the one to be supplied for the purpose of receiving the organizing influence; the other to be removed, having, in the discharge of its function, resigned that influence to its type: the former the materials upon which the new atoms may exercise their function; the latter the old atoms now reduced to inanimate matter. Here then we are conducted to our first general idea of what should constitute a living circulating fluid, namely, water (one of nature's great vehicles for the transferrence of other materials,) holding therein suspended or in solution constituents regenerative and effete.

Having thus arrived at our first general idea of the blood, our next inquiry naturally is—what should we anticipate as to the composition and construction of the regenerative portion of that fluid?

The first anticipation suggested by our preconceived views in relation to the nutrient or regenerative portion of the blood, is that it would be found to contain some highly elaborated product of the operation of vegetable organisms, some residual product or organized mass, which, originally formed from inanimate elements, was pushed progressively forward by link after link in the vegetable portion of the great organizing chain, till it had reached such degree of elaboration as adapted it to the requirements of the animal

links; till, in a word, it had attained to such elevation in the scale of organization, as was required to call into operation the functional action of the first or humblest link in the animal portion of that chain. Analysis of the blood presents to us such an elaboration, in the substance known to us by the name of albumen. We regard albumen as standing in the same relation to animals generally, as inanimate matter stands to the vegetable world.*

In the second place, we should anticipate, in accordance with our preconceived impressions, that in the circulating fluid would be found a multitude of microscopic granules, namely, organizing atoms, various species and varieties of which must be comprised in the construction of so complex an organism. Such granules we should expect to find in the various stages or conditions which would result from the extent to which they had discharged their physiological function. Thus we should look for free granules, namely, atoms whose vital activity had not as yet had commencement; for granules partially enclosed within a membraneous envelope; and for completely enveloped granules constituting nucleated cells. Analysis of of the blood presents to us granules in each such condition.

In the third place, our hypothesis would lead us to look for some product resulting from the operation on albumen, of the functional action of the first or simplest of the species of the animal organizing atoms; would teach us to seek for albumen raised still higher in the scale of organization, namely, elevated to the condition of an animal elaboration;

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* It is a fact well known to physiologists, that even in carnivorous animals, fibrin must be reduced to the condition of albumen before it can become a component constituent of their blood.

in a word, would guide us to search for some organized product, part of which was to be appropriated to the formation of animal structures, while a residual part was to call into operation the functional action of the second link in the animal portion of the chain. Analysis presents to us such product in the spontaneously coagulable constituent of the blood known as fibrin.

To enter upon a general inquiry into the nature of all the regenerative constituents of the blood, would be foreign to our present design; it would be also irrelevant to the object in view, to trace the effete products of decomposition in the discharge of the ulterior functions performed by such products in our economy. With regard to the latter constituents generally, it is sufficient for our present purpose to observe, that, consistently with the views we have ventured to advocate, we should be led to look for inanimate or chemical compounds as forming constituents of the blood, and among such compounds would seek for alkaligenous metals. Analysis presents to us such compounds and alkaligenous metals in the saline constituents of the circulating fluid.

But there is one circumstance, in connection with the products of decomposition, which it is of importance for us now to observe.

In accordance with the views we have been advocating, we should be led to anticipate that, as the result of the functional exercise, or, in other words, as the product of the physiological transformation of those portions of the various organized products which had been appropriated to the formation of the different structures of the organism, such, for example, as cellular and muscular structure, would not be found altogether devoid of the organizing influence;

would not be found, strictly speaking, chemical compounds but would retain something of the nature of organization; for it is the atom, and that portion of its stimulus which becomes that atom's type, which must eventually be reduced to the condition of true chemical compounds. The other portions, even after the discharge of their physiological function, we should expect still to retain something of the character of organization.

Analysis of the blood presents to us such results or such products of physiological transformation in urea, lithic acid, &c. Such substances cannot be said, strictly speaking, to be chemical compounds for they still possess organization.

Should we, then, in the course of our physiological researches, meet, in a complex organism, (such, for example, as man,) with a residual organized product, which we had reason to suppose was not designed as the reciprocal or specific stimulus of any organizing atom above it in the organizing scale, such residual product never itself becoming an organizing atom, we should not expect to find that on the discharge of its physiological function it would be reduced to the condition of a chemical compound. We should then, in connection with such residual product, look for, as the result of its transformation or decomposition, something which still retained, as regards the arrangement of its component constituents, somewhat of the character of an organized structure. That such a residual product, and such result of its decomposition, are found within the organism man, we shall shortly endeavour to show.

But to return to the consideration of the blood.

What, then, is the conclusion at which we have arrived *a priori*, as regards the component constituents of the blood? It is this, namely, that among the essential

components of our circulating fluid would be found—1st. Water, holding in solution an highly organized substance, which has been named albumen, together with a substance still more highly organized, or the result of that albumen's still further elaboration, which substance has received the name fibrine. 2ndly. That in the same fluid would be dissolved chemical compounds, or saline constituents and alkaligenous bases. 3rdly. That in this fluid there would also be in solution certain organic products, resulting from the physiological transformation of the various structures of the organism, which products may be called urea, lithic acid, &c. And, 4th. That suspended in this fluid, which we may now call liquor sanguinis, would be found to float multitudes of microscopic granules, variously enveloped, and otherwise, called granules, corpuscules, and nucleated cells.

Might we say that so far our synthesis is confirmed by analysis?

But there is another constituent which our preconceived conjectures would lead us to look for, as forming an essential component of our circulating fluid.

Nutrition (including secretion) we perceive can be no process of innervation; indeed we see nutrition, as it is called, proceed vigorously where no nervous structure exists. The supervention, then, of a nervous system upon the nutrition of an organism, must be incidental rather than essential thereto—that is, did the required functions of an organism, or, in other words, did the design of its being, admit of its constituent organisms being constantly immersed in what is called their nutrient fluid, its nutrition would not then have been dependent upon nerves. How,

then, we would inquire, is nutrition in the human organism dependent thereon?

We have seen that a necessity exists for constituents regenerative and effete *to be constantly in motion*, and in this necessity have pointed to us the nature of the dependency of nutrition upon a motor apparatus, or, in other words, upon a system of nerves. And as nutrition must be involuntary, involuntary must be those nerves; and thus we are conducted to the ganglionic nervous system.

We would now inquire somewhat more minutely into the nature of the function of this system.

It is an inference at once to be deduced from the atomic hypothesis we just have proposed, and, indeed, independently thereof, one from which none will feel disposed to withhold his assent—that in proportion to the extent, or to the degree of energy with which any organized structure has discharged its physiological function, will be the demand for what are called that structure's regenerative or nutrient constituents. We perceive, from the complex design of the human organization, that the degree of energy with which its various structures have to discharge their physiological functions, must, of necessity, be subjected to a constant variation. If, then, all the structures in our organism be dependent for their organic existence upon the same circulating fluid; and the demand by each for the amount of that fluid required for its nutrition be, of necessity, subject to a constant variation; some provision must, we conceive, have been made in our organism for proportioning the amount of the blood which is sent to each of those structures to its ever-varying demand for a supply; some bond of communion must, we conceive, exist between

the structures and the blood, which can effect a correspondence between the quantity required by the former, and that which the latter shall supply. To each, then—namely, to the structures and to the blood, it would to us appear, we must look for one of the elements of this communion, and in the structures we find that element in the sympathetic or ganglionic nerves. It is a fact well known to the anatomist, that these nerves ramify round arterial tissue to its minutest subdivisions, and thence to the terminal, or what are called capillary tubes. But these nerves can be but one element in the motor apparatus;· there must be something to call into operation their functional action. These nerves, though adapted for the production of motion, must—like that atom in which gravity was supposed dormant in the absence of its reciprocal—like that matter in which caloric was seen latent in the absence of its stimulus—these, like the retina in the absence of light, and hearing in the absence of vibrations; like the simplest organizing agent in the absence of inanimate elements; and like our own complex organism in the absence of food—these, we say, must be ever inactive, till aroused into activity by *something* which has been adapted to that end. These, like the voluntary nerves—in a word, like *all* structures which have been constructed for the manifestation of an operative influence—must have something which stands to them in the relation of reciprocal, or stimulus, to call forth that influence into operative action.

And where should we look for this reciprocal or stimulus? Obviously, as it would to us appear, we must look for it to the blood; but not, as we conceive, to the blood *generally*, or in its aggregated form.

To us it would appear to be scarcely intelligible how the blood generally, or any constituent, such as fibrin, *dissolved* in that fluid, could possibly be competent to accomplish that end. If there be a demand for a *variation* in the degree of energy with which the retina discharges *its* physiological function, will a *constant* amount of light be enabled to accomplish that end? Should it be required that our hearing should experience *modifications in degree*, will *unaltered* vibrations bring that purpose about? And did we require that our movements should be *rapid and slow*, would *unvaried* volition accomplish our view? How, then, can it be supposed possible, that an unvarying circulating fluid, or any constituent held in solution therein, could call into action the function of an organ, the degree of energy in the operation of which must ever be varying?

We could understand how the blood generally, all, or any of its constituents, might be competent to call into action the contractions of the heart, so long as that blood or its constituent were as constant and unvarying as was the regularity of the cardiac contractions. But we cannot well conceive how the blood generally, or any of its soluble constituents, could be competent, by the impression it communicates to the ganglionic nerves, to balance the quantity of blood contained in the capillaries, with the quantity required by the structures for their renovation; unless it be upon the following supposition; namely, that the blood generally, or its constituent; the amount of blood contained in the capillaries; and the demand on the part of the structures for renovation—all three, stand at all times in a fixed and constant relation towards each other. Let us be clearly

understood. What we mean to convey is this, that on the supposition that the blood generally, or any of its soluble constituents, be the specific stimulus of the ganglionic nerves; then the specific stimulus of those nerves, namely, the blood generally, or its constituent; the amount of nutrient fluid contained in the capillaries, namely, the result of the application of that stimulus to the nerves; and thirdly, the demand on the part of the structures for that nutriment, or for renovation, namely, the proximate or essential cause of the application of that stimulus; must, for the fulfilment of the design of nutrition, stand at all times in a fixed and constant relation towards each other. Now we know that the demand on the part of the structures for renovation is *constantly varying*, while we know equally well that the blood generally, or its constituents, are *not*, in the normal condition of the organism, subject to variation; but, on the contrary, that a provision has been carefully made to preserve its components, as well in their absolute as their relative amount, (within certain limits) in a fixed and unvarying constancy. To us, then, the inference would appear to be incontrovertible—that the blood generally, or any of its soluble constituents, cannot possibly be the specific stimulus of the ganglionic nerves. If, then, such be a legitimate deduction, we must look to the blood for a constituent not in solution, and consequently suspended; which constituent must be insulated, or, as it were, independent of the general circulating fluid. But what must be the properties of this insulated constituent? Let us recall to our recollection the end for which this constituent is required, namely, to be the specific stimulus of the ganglionic nerves, whereby the amount of the circulating fluid sent to each of the tissues is

to be proportioned to a constantly varying demand for a supply. To us it would appear that no agent could be competent to accomplish this end, unless within it were fulfilled the two following conditions, namely—first, that between this agent and the tissues demanding renovation there existed a force of attraction; and secondly, that the intensity of this force varied directly as the demand on the part of the tissues for renovation—that is, that in the same ratio as the demand on the part of the tissues for renovation becomes greater or less, will the intensity of the force of attraction between those tissues and the specific stimulus of the ganglionic nerves become proportionably augmented or weakened.

Thus, then, when a tissue has a demand for its nutrient fluid, the specific stimulus of the ganglionic nerves is attracted to that tissue's capillaries, and an impression is thereby communicated to the peripheral extremities of the sympathetic nerve, as they ramify round those capillary tubes; this impression is propagated centripetally to the great ganglionic centres, and an amount of motor influence, proportional to the degree of stimulus communicated to the extremities of the nerves, is re-propagated in the direction of the capillary tubes; and the quantity of the nutritive fluid thereby sent to the tissue is exactly proportional to the degree of stimulation employed, and consequently to the demand on the part of the tissue for a supply. If such be the case, we can readily understand how the individual condition of the minutest capillary must partially influence the cardiac contractions, and can recognize a rational and simple explanation of all the phenomena of what is commonly called symptomatic fever.

We shall now proceed to point out in what manner we conceive all such conditions may have been fulfilled in our organism; nor do we do so altogether without feelings of diffidence, from the consciousness that we are but proposing an hypothesis.

In the first place, then, we again shall inquire what our preconceived conjectures would lead us to anticipate, in relation to the mode of constructing such a constituent? We should be naturally led to anticipate that, for a function so important, and for properties so varied—(varied, in being at once the specific stimulus of the ganglionic nerves, and an agent to be attracted by the tissues as they are undergoing degeneration, or demanding renovation*)—a structure of a high degree of organization would be required; while this structure, not being designed as a residual product, to call into operation the functional action of any organizing atom above it in the organizing scale, it would be insulated from all atoms but its own, and consequently its circulating fluid, if such term be admissible, must be insulated from the general circulating fluid, or from the blood.

Does our acquaintance with the uniform laws which control physiological operations generally, enable us to form any *a priori* conjecture as to *how* such provision would be made in the blood?—as to *how* an organized structure required to be integral, insulated, and independent, would be formed within the general circulating fluid? We conceive

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* With the additional functions attributed to it by Liebig, and which it doubtless possesses, of conveying into the organism oxygen, and removing from it carbon.

it does; and by such acquaintance should be guided to look for the following as constituting that process. We should expect to find that an organizing atom in the form of a microscopic granule would exist in the blood, whose function was to give being to that organized structure. We should expect that this granule having formed around itself a membraneous envelope, this new structure being required to be insulated and independent of the blood, would, when formed, be retained within this membraneous envelope, and with it of necessity its circulating fluid. And what should we look for as the essential component of that circulating fluid? We should look for water holding in solution constituents regenerative and effete—that is, we should look for an albumonoid substance, from out which this required organized structure could be formed; we should look for this organized structure itself; and we should look for a partially organized product of this structure's organic degeneration.

Let us call this membraneous envelope, thus loaded, a nucleated cell or corpuscule, and its granule or atom the nucleus of that cell. Let us name the fluid contents of this cell the liquor corpusculi, and give to the albumonoid regenerative constituent the appellation of GLOBULIN. Let us designate the required organized structure HŒMATOSIN, and the product of that structure's organic degeneration HŒMAPHAIN;* and again we ask, might we say that our

* This constituent being effete, and consequently rapidly removed from its organism, we should be naturally led to expect would with difficulty be found, upon analysis, within the corpuscle; but consistently with what our preconceived conjectures should have led us to anticipate, it is found, like urea, lithic acid, &c. to be possessed of something of the character of organization.

synthesis is confirmed by the analysis of the coloured corpuscle of the blood? *

Here, then, in this minute corpuscle we can recognize the analogue of the great general vascular system, as containing within it its varied contents. The membraneous envelope representing the vascular parieties, the liquor corpusculi corresponding with the liquor sanguinis of the blood, containing in solution its constituents regenerative and effete, while, suspended therein, floats the atom, the analogue of the granules of the blood.

Having directed attention to what we regard as the physiological process essential for the development of Hœmatosin, we shall now proceed to point out how we conceive that structure is attracted to the tissues, during their demand for renovation, with a force the intensity of which varies directly as the urgency of that demand.

When we bear in mind the extremely limited number of the species of the elementary components of this world, and at the same time reflect on the frugality with which nature appropriates those elements, when she employs them as the agents to carry into execution her designs; when we further contemplate the great results we see developed from what to us might appear comparatively trifling and inefficient means; we feel assured that no constituent will be found to form a constant component of an organized

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* We would beg to observe, that whatever be the function of Hœmatosin, it can in no way interfere with the correctness, or otherwise of the supposed mode of its physiological development; and should the latter be regarded as consistent with probability, we would offer it as an additional argument in support of our organic atomic theory.

structure, unless the demand for such constituent be urgent; that no element, it matters not how minute be its proportion, will invariably exist as a part of the construction of a structure, unless the presence of that element were of moment to that structure's function.

When we find in an organized being a structure possessed of properties peculiar to itself—say, for instance, their peculiar contractility in muscles—we feel justified in supposing that it is in consequence of its possessing this peculiarity of property, that such structure was made to form a part of that organized being. And when we see in an element an attribute which places it pre-eminently apart from those of all other species of matter, if such element be found invariably a component of an organized structure, shall we not be justified in proposing the inquiry, is *this* the property which is of moment to that structure's function?

In the range of inanimate attributes, there is none which to us appears to be more remarkable and striking, than the electro-dynamic, or magnetic properties of the element iron. In this respect iron is conspicuously removed from all other known species of matter.* Iron is found invariably to form a component constituent of hœmatosin. And will it be regarded as inconsistent with probability—will it be esteemed as an irrational hypothesis, to suppose that the electro-dynamic, or magnetic properties of iron, are brought into operation in the functions to be fulfilled by hœmatosin? We trust not; for to us it would appear as though each

* The magnetic properties of nickel, if they exist, which by Faraday is denied, are certainly very remotely distinct from those of iron.

little corpuscle, as it wandered through our blood, bore *some relation* to what might be called, if such term be allowed, a living migratory magnet permeating our system to control the distribution of its nutritive fluid.

But if such be the case, let us now inquire how the movements of such magnet are controlled.

It is a fact with which chemists are familiarly intimate, that according as chemical combination is proceeding, developement is given to electricity; the amount thereof developed bearing a constant relation to the energy with which the process of combination proceeds.* Here, then, we see that as disorganization proceeds in our organizing atoms; or, which is the same thing, as the demand on the part of the tissues for renovation becomes urgent; the electricity developed attracts (if our views be correct) the hœmatosin to the tissues with a force which must be proportional to the extent of its developement, and consequently to that of the demand of the tissues for renovation, or for the circulating fluid. The hœmatosin, then, having reached the point where nutrition is required, communicates its stimulus to the ganglionic nerves; but now, becoming surcharged with electric influence, and consequently *repelled* and not attracted † by the structures requiring renovation, while at the same time urged forward by the *vis a tergo* itself has called into action, this hœmatosin is hurried into the torrent of the venous blood. But let us follow it still further in its course. In the capillaries it has

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* See experiments of Becquerel, De la Rive, and Pouillet.

† *How* such could be the case, will be simply intelligible to all who are familiar with the phenomena of electro-dynamics.

taken up not alone electricity, but also, as Leibig observes, carbon: both it hurries forward *to part with in the lungs*; here, then, it again becomes attractive to the tissues, and a second time proceeds on its circuitous career.

Let us now suppose the mechanism of man's organism to have reached its completion, and that the process of living is proceeding therein: let us behold his vascular system now replete with nutrition, and oxygen furnished in the air that he breathes; *how*, to accord with the views just promulgated, should we expect that the process of life would proceed?

It would be thus:—

In the oxygen of atmosphere is furnished that agent which can cause disturbance in the chemical attributes of the atom's components; in nutrition is supplied the stimulus or reciprocal of that atom which can involve it in action; these two conjointly constitute *all* that is required by that atom to call into operation its physiological function. As that function proceeds, there is demand for renovation, to fulfil which demand the atom developes electricity. Electricity attracts hœmatosin to the vicinity of the atom, and hœmatosin communicates a stimulus to the nerves of the capillary. These nerves convey tidings of the demand to the great centres which engender involuntary motor influence; from which centres is sent forth the precise amount of that force which at that time is required. This force urges forward nutrition, which, in the form of Liquor Sanguinis, escapes the barriers of the capillary parieties, and furnishes the supply of nutrition which the atom demands; while the same force pushes onward hœmatosin, now replete with the electricity and carbon it has just imbibed.

The hœmatosin having reached the lungs, must then, (like the atom which just before had attracted it,) undergo a process of degeneration or reduction, in order to part with its carbon, and combine with it oxygen; and thus (like that atom) must give extracation to the electricity it had from the atom imbibed, and be again restored to that condition in which we saw it attracted to those structures for which renovation was required.

On this hypothesis it at once becomes obviously evident, that every diminution of the absolute amount of the coloured corpuscles contained in the blood must, after the lapse of a short period of time, proportionally augment the relative amount of the fibrin which will be contained within the vascular system. The fibrin, it is designed, should be extravasated beyond the capillary parieties for the renovation of the tissues, while the corpuscles are the agents which regulate the amount thereof which shall be so extravasated. Remove, then, the corpuscles altogether from the blood, and the result will be that no fibrin will escape, and we shall have a maximum amount thereof contained within the vascular system.* Diminish the absolute amount of the corpuscles, and there must after a short time be, from the same cause, a proportional augmentation of the relative amount of fibrin contained within the vascular parieties.

Every loss of blood must obviously diminish the absolute amount of the corpuscles contained in the blood; and every physician as well as every physiologist well knows

* *How* a similar result occurs during the acute inflammatory process, we trust we shall shortly be enabled to show.

that the effect of such loss is to augment the relative amount of fibrin found in the blood which is subsequently lost, a fact for which no explanation that we are aware of has ever as yet been proposed.

What a beautiful provision is here recognizable for the suppression of hæmorrhage, the tendency to which is inversely proportional to the amount of fibrin in the blood.

We shall, in conclusion, hazard but a single argument in support of the opinion, that hœmatosin is the specific stimulus of the ganglionic nerves, an argument we have derived from pathology; and we do so half reluctantly, from the fact that it, too, is no more than hypothesis.

It is a truth with which all are so familiar in their own persons individually, as to make it undesirable we should now pause to offer any explanation of its physiological cause, although such explanation could involve in it no possible difficulty: it is, we say, a fact, of which all are made personally aware, that the due exercise of the physiological functions of every organized structure, is essential to the retaining of that structure in a condition of physiological perfection. An organized structure unexercised degenerates, all know, into that condition which has received the name *atrophy*. If, then, the function of hœmatosin be to stimulate the ganglionic nerves, the withdrawal of those nerves, or the suspension of their function, must be succeeded by an atrophy of hœmatosin. If, from any cause, a large portion of those nerves had for a period their function suspended, we should be led to anticipate a degeneration in a corresponding proportion of the coloured corpuscles of the blood.

If, then, an organ of paramount importance to the

existence of a species, an organ whose nutrition it was designed should at a definite period of its developement, undergo an augmentation to no ordinary degree, and furnished, with the design of effecting such nutrition, with an extraordinary amount of the ganglionic nerves: if, we say, such organ were at that fixed period of its development withdrawn from the rest of its organism, thereby leaving the function of its ganglionic nerves undischarged, should we not be led to anticipate, to a corresponding extent, an atrophy of the coloured corpuscles of the blood? And if that organ, although unremoved from its organism, had from some cause, at that period, its function suspended, can it be supposed that the coloured corpuscles of the blood would be altogether exempt from degeneration or atrophy?

That organ is the uterus, and the period is puberty. Woman, destined to exist in two distinct physiological conditions, has had provision made in her organism for the fulfilment thereof; and is it consistent with experience or reason to suppose, that the function of an organ so momentous to creation could be wholly suspended, and the general organism be exempted altogether from detriment therefrom? We conceive not; and such we regard as one great element in the pathology of those diseases called anœmia and chlorosis,* although

* The symptoms, as also the means found by physicians to be of most avail for the removal of such diseases, would tend to corroborate our view of their pathology.

For what are those symptoms? They are,

First—Irregularity in the cardiac contractions, or what are called

dependent upon *all* causes which can adequately suspend the function of the ganglionic system of nerves.

We shall be told we propose hypothetic opinions, and

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palpitations of the heart; arising, (as we suppose,) from the abnormal condition of the stimulus of the nerves of that organ.

Secondly—Depraved nutrition, (including secretion) with local accumulations of blood, giving rise at one time to frontal headache, at others to distress in the gastric region, hypocondria, &c. arising, (as we suppose,) from an inadequate supply of the specific stimulus of the nerves of the capillaries.

Thirdly—A pallid and *chlorotic* hue of the surface, arising, the former, as is well known, from a deficient amount of the coloured corpuscles of the blood, and the latter (as we suppose) from an excess of hœmaphain, or some such result of decayed and decaying hœmatosin; as also the retention within the system of the catamenial excretion.

Fourthly—Amenorrhœa. But what is amenorrhœa?

To us it would appear that nature has not left, *altogether* unprovided for, a contingency of such moment as the suspension of the human uterine functions. In the necessary elimination from the system of those constituents, which, in a normal condition of the organism, would have become hœmatosin, to stimulate the ganglionic nerves of the uterus, we can, we conceive, recognize the necessity for a periodic catamenial excretion. It is, we conceive, when the hœmatosin within the organism has become so far atrophied or degenerated, as to render it inadmissible that any thing adapted for the formation of that substance should be eliminated from the organism, that, conjointly with anæmia, we have the distinct disease called amenorrhœa, and which two diseases in conjunction may be said to constitute chlorosis.

And what are the means found most efficient in the relief of such symptoms? They are—

First—The physiological action of the organ whose function has been suspended.

Secondly—All means which can increase the nutritive process, and consequently the functional action of the ganglionic nerves—viz. exercise of the tissues with the free access of pure air, which conjointly consti-

[illegible] but may not an [illegible] and *might not* [illegible]

[illegible] and consequently their [illegible] and a corresponding increase in the [illegible]

[illegible]

attempt their support by hypothesis: but may not an hypothesis suggest experimental inquiries? and *might not* experimental inquiries demonstrate its truth?

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tute the efficient means for the reduction of those tissues, and consequently their demand for renovation, and a corresponding increase in the functional action of the ganglionic nerves: and

Thirdly—Ferruginous medicines which supply the magnetic component of hœmatosin.

FINIS.

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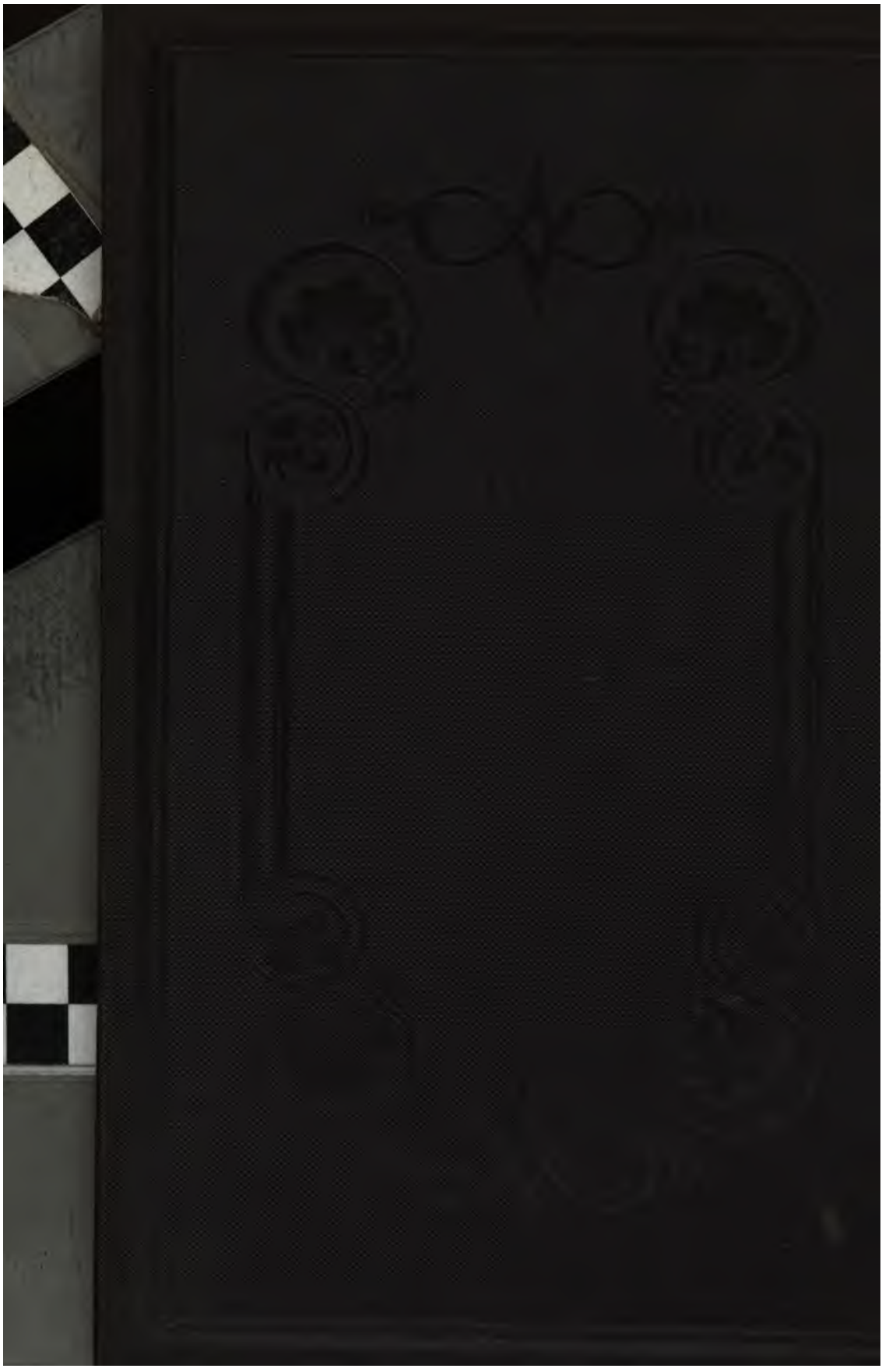
Page 39, fifth line from end, for *agent*, read *agency*.
Page 45, twelfth line from end, for *that*, read *this*.
Page 48, seventh line from top, for *the* function, read *a* function; and for *organism*, read *organisms*